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ABSTRACT

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Project No. 8-0264
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Herbert J. Kiesling

Indiana University

Bloomington, Indiana

February, 1970

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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Herbert J. Kiesling

Bloomington, Indiana
February, 1970

SUMMARY

This is a study of the relationship of a number of school and community characteristics to achievement performance levels of fifth and eighth grade pupils in a 1965 sample of 99 school districts (86 usable) in New York state.

A simple model of the educational process was constructed and the relative importance of a number of school inputs compared. Units of observation used were both schools and school districts. Results were compared to a similar study of an earlier (1958) sample of New York school districts.

The key findings of the investigation are the following:

1. The school input most consistently related to pupil achievement levels was resources devoted to central administration and supervision.

2. A second school attribute often related to pupil performance, especially in grade 5, was level of teacher certification. Teacher experience level was also related to performance, but only for pupils from good socio-economic backgrounds.

3. Several school inputs normally considered important were not related to achievement performance outcomes. These include teacher degree level, teacher salary level, value of school district owned plant and equipment, and principals and supervisors to pupil ratio. The findings for the salary and value variables conflict with findings in the earlier New York study.

4. Number of students per classroom was found to be positively related to pupil performance, a finding which suggests that the number of classrooms available in these schools was not a meaningful constraint.

5. Differences in performance outcomes were found to be much more significant between school districts than within school districts, although within-district relationships were not completely random, even when pupil socio-economic differences were controlled.

I

INTRODUCTION

Schools Considered as Firms

In recent years considerable attention has been given by economists to the possibility of studying public schools as if they were firms. This has required some measure of educational output similar to those usually available for studying private industry.

In analyzing firms, economists usually deal only with the quantity of output. For example, when speaking of tons of a certain grade of steel, production levels can be compared by analysts secure in the knowledge that quality differences are by definition of the product non-existent. In studying public education, however, it is impossible (at least in practice) to define quality differences away. Merely comparing the number of pupils moved through the educational system does not give the researcher enough information about the character of the "manufacturing" process. In public education, as in most public services, there is also an important quality dimension.

In recent years it has become apparent that objective test scores may be adequate enough measures for output quality in the public schools (and especially at the elementary level) such that economists might be able to turn their expertise in studying the firm to work in the study of public schools. The first full-scale study to show the possibilities of this was the author's doctoral dissertation, completed at Harvard University in 1965. The most extensive effort was however the Equal Opportunities Survey of 1966. Other work has been done by Katzman using Boston data, by Peaker using British data, Burkhead for two city school systems, and by several authors using data generated in the Equal Opportunities Survey.

Herbert J. Kiesling, "Measuring a Local Government Service: A Study of Efficiency of School Districts in New York State," (unpublished Ph.D. dissertation, Harvard University, 1965).

--------, "Measuring a Local Government Service: A Study of School Districts in New York State," Review of Economics and Statistics, (August, 1967), pp. 356-367.

Martin T. Katzman, "Distribution and Production in a Big City Elementary School System," (unpublished Ph.D. dissertation, Yale University, 1967).

James S. Coleman, et.al., Equality of Educational Opportunity (Washington, D.C.: U.S. Government Printing Office, Washington D.C., 1966). (Commonly known as the Coleman Report.)

Eric A. Hanushek, "The Education of Negroes and Whites," (unpublishe Ph.D. dissertation, M.I.T., 1968).

Jesse Burkhead with Thomas G. Fox and John W. Holland, Input and Output in Large City High Schools (Syracuse: Syracuse University Press 1967).

G. F. Peaker, "The Regression Analyses of the National Survey," Children and Their Primary Schools (London: Her Majesty's Stationery Office, 1967).

Notes: Continued next page.

This kind of work proceeds at two levels. What economists ultimately would hope to accomplish is the construction of accurate production functions for schools. To the economist a production function of an industry represents a listing of optimum levels of output associated with various combinations of (physical) inputs into the production process. Production functions _per se_ in the private sector would not be provided by economists but by engineers. The task of the economist is to add cost considerations and to compute which combinations of inputs are (most) efficient.

Crucial to the formulation of production functions is for the analyst to be aware of what the firm is attempting to maximize and to reduce this maximand to a single dimension. If this can be assumed, it is merely necessary to observe which firms are operating most efficiently with respect to the single output (or output index) and then to study the input configurations used by those firms.* Another important consideration for the construction of production functions is that it is possible to experiment concerning the degree of complementarity and substitutability of various inputs to the production process.**

It is unlikely that economists can reach the goal of obtaining formal production functions for education as defined above, for several reasons. It is not possible to know for certain exactly what schoolmen wish to optimize or to discover how complementary various inputs are. Also, it is difficult to reduce educational output to a uni-dimensional index. Of these problems, it will become apparent below that the complementarity problem is probably the most intractable, at least at the elementary school level. Schoolmen probably strive to instill knowledge in basic subjects in the lower grades and this competence probably occupies a preponderant percentage of the total output at that level.

The second level at which this investigative work proceeds is in the more mundane area of describing school performance and discovering crude (but important) policy implications which might be forthcoming from such description. A further goal is to discover in general which types of educational inputs are associated with high performing schools when pupil socio-economic differences are controlled.

Also an interesting study is presently being conducted by Eric Hanushek and the RAND Corporation where pupil performance is being related to teacher characteristics and other variables for a large sample of pupils in the Norwalk-El Mirada School District, California.

*In practice, assuming rational firm behavior, it is difficult to obtain more than one such configuration since only one combination of inputs is most efficient at any one combination of prices. Additional information is available over time if there are more fluctuations in factor prices than in production technology.

**Factors are complements when they must be increased _together_ to provide increased output and substitutes when one can be used _in lieu_ of another.

Such information may also have important suggestions for policy. It is at this second (lower) level that the present study should be placed.* Further comments concerning how this type of analysis might be useful to policy makers and other students of education will be included in the final section below.

Some Previous Work: Are Schools Important?

Of the work which has been done relating school and community characteristics to objective test scores, much has yielded findings which seem to demonstrate that the formal school process is relatively unimportant to educational success. The most noteworthy example of this is the Equal Opportunity Survey (Coleman Report) which has popularly been interpreted to show that nonschool environment is of far greater importance to educational success than is anything done by the schools. While this interpretation of the Coleman findings is somewhat erroneous, and while the statistical analysis which provided it is suspect, nevertheless the Coleman study has still been widely considered to be a real challenge to the efficiency of American school performance. Other studies have yielded fairly similar results. One by Burkhead, Fox, and Holland**analyzed a number of performance measures for 39 Chicago high schools, 22 Atlanta high schools, and 174 small community high schools used in the Project Talent study. Few school characteristics were significantly related to outputs when allowance was made for differences in median family income. A study of Boston schools by Katzman showed socioeconomic status as the only variable consistently related to all the measures of output.

There exist grounds for believing that the negative findings of the three studies just mentioned are overstated however. Other investigators--notably Eric Hanushek and Henry Levin--have shown that, when used in better educational models, the Coleman data yields findings which show teacher characteristics to be strongly related to pupil performance. Similar findings were obtained by Peaker for a 500 student sample taken from British primary schools and are being obtained by Hanushek in a presently ongoing study of pupil performance in Norwalk-El Mirada California being sponsored by the RAND Corporation. All three of the studies giving negative conclusions had statistical designs which left something to be desired. Finally, some earlier work by the author shows some school characteristics--especially administrative effort, teacher salary paid the top teacher, and value of school plant and equipment--to be strongly related to pupil performance fairly consistently. Some unpublished work by the author done for 647 public high schools in the Project Talent sample seems to show the same thing.

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*Although the author hopes that in the course of the analysis some light might have been shed on the problems associated with the development of formal production functions as well.

**Op.cit.

Empirical Analysis Directly Precursive to the Present Study: The First Quality Measurement Project

The group of people which collected the data which makes the present study possible also gathered a set of high quality data for performance of a sample of New York schools in 1958, 1959, and 1960. Since this group was formerly called the "Quality Measurement Project," I refer to the earlier study as the First Quality Measurement Project and the 1965 study, that which this report is based upon, is correspondingly termed the Second Quality Measurement Project. For brevity the two studies will be referred to below as the 1958 and 1965 studies respectively. The author has over the past several years carefully analyzed the 1958 data, and since the two samples are relatively similar ones from the same state, the earlier findings comprise highly relevant background material for the present study. It can certainly be said that the earlier findings constitute a ready-made set of hypotheses to be tested with the 1965 data. It is proper therefore to relate the earlier analysis and findings in some detail. To do this it will first be necessary to discuss the characteristics of the earlier sample.

The first Quality Measurement Project was a three-year study at three grade levels for 97 of the approximately 1400 school districts in New York state in 1958. The fact that the study was maintained for three years gives it an important longitudinal aspect; students tested the beginning year were "followed" the succeeding two years. The three beginning grade levels tested were grades 4, 7, and 10, although most of the author's analysis has been concentrated at the lowest grade level. The test instrument used for grades 4, 5, and 6 was the Iowa Basic Skills battery. Members of the Quality Measurement Project, as well as the author, collected a number of other important school and community characteristic variables for each of the 97 participating school districts. The most important of these are included in the following list.

(1) Teacher-Pupil Ratio

(2) Principals/Supervisors to Pupil Ratio

(3) Special Staff Personnel to Pupil Ratio

(4) Expenditure per Pupil on Books and Supplies

(5) Median Teacher Salary

(6) Average Salary of Teachers in the Top Salary Decile in Grades Kindergarten Through Six

(7) Average Socio-Economic Index of Occupation of Family Breadwinner of Pupils in Grade Five

(8) Amount of School District Debt per Pupil

(9) School District Average Yearly Growth Rate, 1950-1958

(10) School District Size in Average Daily Attendance

(11) School Property Value per Pupil

(12) The Salary of the Superintendent of Schools

(13) Median Salary of Principals

(14) Expenditures per Pupil on Principals, Assistant Principals, and Supervisors

(15) School District Value of Buildings per Classroom

(16) School District Value of Furniture and Equipment per Classroom

(17) Median Years of Teacher Experience in the School District

A few community characteristics such as tax rate, tax base per pupil, and geographical setting (village, urban, etc.) were gathered. Other community characteristics was difficult to obtain because school district boundaries are seldom coterminous with jurisdictions used by the U.S. Census. Also found useful were the variables for size of school district, growth of school district, and figures on expenditure per pupil.

Educational Models Used

The researcher, in order to construct a useful model of the formal education process, most proceed in two steps. First it is necessary to provide a framework which meaningfully places the formal school process in proper perspective and secondly, which is much more difficult, he must construct a model for studying the production function of the process itself. For the first step a basic representation of the educational process was assumed wherein the quality of a child's education is causally related to four variates--the formal school education process, the informal home and environmental educational process, motivation towards leaving, and native ability. In order to examine the formal school process the other three influences must be properly taken into account. This is difficult to do in a single equation model because of the many interdependencies in the educational process. For example, pupil motivation is a function (at least) of home environment, influence of peers, school environment, and past success or lack of it on the part of the individual pupil. All these influences are most difficult to capture. The assumption made in the single equation model used in this analysis is that the motivation caused by socio-economic environment (including influence of peers) is captured by isolating family and school socio-economic factors while that caused in the school (again including peer influence, but also that imparted by teachers etc., and by the pupils' past success) is captured in the level of achievement test scores themselves.*

Most economists who have investigated school input-output relationships seem to feel that no separate accounting is necessary for differences in native ability either, paradoxical as that may seem. The reason for this is that it is assumed that native ability is either randomly distributed or associated with socio-economic background of the pupils. No variable is needed of course if the distribution of native ability is random. If associated with socio-economic status, it is proper to account for it with a socio-economic status variable. The author concurs in this conception of the educational world, although he is at the same time aware that the formulation is by no means unassailable. Thus, there may be some non-random variation in native ability not associated with socio-economic factors. This is a point which will stand considerable further investigation.

It should be most apparent how very crucial it is to properly account for socio-economic environmental influences upon school children if we are to learn anything about school quality. Not only is educational interest and motivation strongly affected by the educational attitudes of the pupils' parents, friends, and classmates, but also a great deal of actual learning takes place in the home with the amount depending very closely upon the educational levels and interests of parents, brothers, and sisters. In the educational models which have been used by the author for these two sets of New York data, the effects of socio-economic differences are accounted for in two ways. First, pupils are stratified into fairly homogeneous groups according to either father occupation or father education. This, it is hoped, isolates the influence of home environment upon motivation and learning of basic subject matter in the home. Secondly, a continuous variable is introduced into the estimating equation to account for the overall socio-economic "climate" of the school itself, including the influence upon motivation of the attitudes of peers. For the 1958 data set the variable used was average level of father occupation for all the pupils in the school district and for the 1965 data a similar variable was used reflecting average education of the pupils' mothers.

The second step, that of constructing a meaningful model of the formal school process itself, is much more difficult given the type of information generally available to researchers. As already discussed, required is to isolate the key inputs considered in physical terms and to compute the marginal product of each assuming all the others are held constant (i.e., in the sense of a partial derivative) and also to discover which sets of inputs are complements to each other.* All this is impossible with data limitations such as those present in these New York studies, or indeed, in any studies made up to now. In practice the idea is rather to find the school characteristics which seem to be important in successful schools ("successful" in the sense of having thoroughly accounted for socio-economic influence) and also perhaps, to make computations concerning the efficiency of the successful inputs. This can be done although the researcher still cannot be certain that his model is completely meaningful because of the absense of an adequate underlying theoretical structure and because in practice many school (and community) inputs are highly colinear. This last problem causes severe estimating problems in practice because colinear variables in multiple regression analysis tend to have overstated standard errors of regression coefficients which tends to understate their true value. Given this situation the investigator is faced with the difficult choice of accepting the indifferent (and understated) significance levels of his variables or to discard variables from the analysis which may well be important.

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*The latter assumption is certainly operationally valid for the investigator who is more interested in the end results than in the processes through which the results are obtained. Unfortunately, if researchers are ever to obtain precise school production functions for schools, these processes will have to be understood.

The author, in dealing with this problem in both New York studies, used two procedures to help in model specification. The first of these is factor analysis, which is a helpful technique for exploring relationships between groups of colinear variables.** Second, considerable experimentation was done in introducing different combinations of variables in multiple regression equations in order of contribution to the coefficient of multiple determination. This procedure, while highly heuristic, nevertheless yields important statistical insights which allow the researcher at least to discard variables which never contribute explanatory power to the model. If there are also reasons for the researcher to think that such variables are theoretically unimportant, he may eliminate them from the investigating model with a minimum of danger.

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*A theoretical basis for such an exercise, assuming data availability is provided by a somewhat modern updating of the old factors of production of land, labor, and capital. A more accurate concept of factor inputs has two basic, or "raw" factors of production and two additional factors which are merely improvements upon the starting raw materials. The two starting factors are human and non-human resources in unimproved form with the improvements on each being human and non-human capital. For purposes of an analysis of schools unimproved human resources would not necessarily be completely uneducated persons. Instead some starting point common to all human inputs, such as high school or even college graduation, can be used as the benchmark for "unimproved" human inputs with improvements on this--training toward advanced degrees, in-service training, job experience, etc., being considered as components of human capital inputs. The distinction for non-human capital should be obvious. Acres of land is unimproved capital while buildings and slide projectors are improved non-human capital, or "capital" in the traditional sense.

**For examples see: Massy, William F., "Principal Components Regression in Exploratory Statistical Research," Journal of the American Statistical Association, (March, 1[illegible]).

John Meyer, and Gerald Kraft, "The Evaluation of Statistical Costing Techniques as Applied to the Transportation Industry," American Economic Review, Vol. 51, No. 2, (May, 1961).

John T. Scott, Jr., "Factor Analysis and Regression," Econometrica, Vol. 34, No. 3, (July, 1966).

For the 1958 data, the factor analysis for the school inputs is given in Table 1. A three-factor rotation was obtained which was disappointing in that many of the important school variables were closely associated together in the first factor, which of course merely reimpresses the researcher with the essential colinearity of the data. The other two factors were more identifiable however. One consisted of variables indicating resources going toward school administration-supervision, while the other included variables denoting amounts of physical plant and equipment (in dollar terms) per pupil used by the school district.

Using these two techniques, the following multiple regression estimating model was obtained for analysis of the 1958 data:

$$Y = b_1 + b_2 O + b_3 T + b_4 E_b + b_5 S_{10} + b_6 V + b_7 E_s + U$$

where:

Y = Average achievement score of pupils in the relevant grade and occupational grouping

O = Index of average occupation of breadwinners of pupils in grade 5

T = Number of teachers per 1000 pupils

E_b = Expenditure per pupil on books and supplies

S_{10} = Average salary of teachers in the top salary decile

V = Value of school district owned property per pupil

E_s = Expenditure per pupil on principals and supervisors

U = Unexplained variation

The last two variables were suggested by the factor analysis but were also found to be important in general. In the starting list of variables, there were three each for salary and value. As might be expected these two sets of variables were found to have high within-set correlations and therefore only one from each set was used. The salary variable correlations were particularly interesting. It would seem that "salary policy" is a school characteristic which suffers from being divided much further.

Before proceeding to a discussion of the findings obtained when this model was fitted to the 1958 data, it is necessary to discuss one more problem in estimating school input-output relationships from these data. In constructing production functions for some production process it is necessary that the investigator be dealing with the proper sized units of production. Thus with a steel manufacturer, the proper production unit is probably the individual plant, not the entire company. With schools this is a particularly perplexing difficulty since there are a number of levels of production involved, with the proper level for investigation dependent upon the individual

Table 1

Factor Loadings, 19 School Characteristics,
86 New York School Districts, 1958 Sample

Variable	Factor Number 1	2	3
1. Teacher to pupil ratio	.64		
2. Principal to teacher ratio		.95	
3. Special staff personnel to pupil ratio			.32
4. Expenditure per pupil: Books and supplies	.63		
5. Expenditure per pupil: Health services	.66		
6. Average salary, teachers, top salary decile, grades K-6	.94		
7. Average number of years teacher experience	-.53	.43	
8. Average salary, teachers, top salary decile, grades 7-12	.94		
9. Principals and supervisors to pupil ratio		.96	
10. Number of pupils per classroom			.47
11. Value of school district assets per pupil	.55		.65
12. Salary of the Superintendent	.79		
13. Mean teacher salary	.92		
14. Teacher salary incentive	.74		
15. Expenditure per pupil on principals and supervisors	.46	.37	
16. Value school district buildings per pupil	.32		.85
17. Value school district furniture and equipment per pupil			.42
18. Mean salary of principals	.81		
19. Administrative salary incentive			
Factor Representation	Expenditure and Salary Policy	Number of Principals and Supervisors	Value of School Facilities
Percentage of total variance	37.6	13.2	7.4
Eigenvalue	6.93	2.33	1.23

Table 1 Notes

Notes: Teacher experience information was missing from 29 of the 86 school districts used for this rotation. The information given for that variable comes from a rotation of 57 school districts and must be regarded as an approximation from the standpoint of all 86 school districts.

Eighty-six school districts were used in this rotation instead of the 89 used in Table 4 because there were three school district for which the salary of top 10% of teachers was not available.

Only factor loadings in excess of .30 are included in the table.

Number of Factors: Using a test developed by Bartlett the three-factor breakdown is clearly correct. The applicable ratio for the last factor is 2.33/1.23, or 1.89 which is significant at the 1% level. The applicable ratio for the next factor is 1.23/1.00, or 1.23 which is insignificant. (See M. S. Bartlett, "Internal and External Factor Analysis," British Journal of Psychology (Statistical Section), 1, (June, 1948).

factor input being studied. Thus, for the central administration this would be the school district, while for administration by building principals it is the individual school building and for teachers it is probably the individual classroom. Thus far it has not been possible for most investigators to obtain very good data for factor inputs by school building and in the 1958 data especially, most of the data are aggregated on the basis of the school district. There is a serious potential criticism of using school district aggregates for many important factors, especially teacher characteristics, if there is any reason to believe (and it seems highly plausible) that such characteristics vary by school building within the same system. In order to control in part for this danger, school districts were examined for heterogeneity. While information was not available by school building for factor inputs, it was so available for pupil occupational backgrounds. Since differences in socio-economic characteristics with school districts provide the most apparent motive for teaching (and sometimes administrative) personnel to transfer within the same school district, such differences should be relevant. When this was done it was found that seven of the 89 usable districts were excessively heterogeneous and those districts were discarded from the analysis. This procedure is not a completely satisfactory one for dealing with the problem of course and the assumed existence of within-district heterogeneity becomes an important hypothesis which was tested in this study of the 1965 data where some information on input variables was available by school building.

Findings From the 1958 Data

The principle findings from the first New York study are well represented by the fitted multiple regression equations shown in Table 2. The findings given there pertain only to the 46 urban school districts in the study as it was found that there was no meaningful relationships between the school variables and pupil performance in the rural and village school districts in the sample. Only the socio-economic occupation index was found to be significantly related to pupil performance in those districts. One task of the present study, therefore, is to examine why the behavior of the smaller districts should be so much more random than that for the urban districts.*

A further word of explanation is necessary concerning the regression equations presented in the table. Two fitted regressions are given for each socio-economic population. The explained, or dependent, variable in both equations is average sixth grade score (composite score, Iowa Test of Basic Skills) for pupils also present in grade four. The

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*A number of hypotheses are possible concerning why the village and rural districts exhibited such random behavior. Since there were only 12 rural and 15 village districts in the sample, their small number might provide part of the explanation. This is especially true were each group to be treated separately. Also these districts are widespread geographically and often in non-competing teacher market areas. It is feasible, also, that the smallest districts are shaped much more by personality attitudes of individual administrators and teachers.

Table 2

Fitted Multiple Regression Equations,
46 Urban School Districts, 1958 New York School Sample.

Socio-Economic Group (Occupation of Family Breadwinner)	Inter-cept	Index of Occu-pation	Teacher Pupil Ratio	Per Pupil Expendi-ture on Books and Supplies	Teacher Salary Top Decile	Value of School Property Per Pupil	Per Pupil Expenditure on Princi-pals and Supervisors	Fourth Grade Score	N	$\bar{m}$	$\bar{s}$	R^2[b]
1. Professional Persons	2.26 (0.21)	0.127 (1.30)	-0.012 (1.42)	-0.0065 (0.70)	0.0013 (0.29)	-0.00065 (0.10)	0.0017 (8.76)**		44	2.64	0.36	.708
	3.80 (0.18)	0.179 (2.07)*	-0.011 (1.47)	-0.0030 (0.37)	0.0018 (0.46)	-0.0014 (0.25)	0.015 (8.34)**	0.701 (8.37)**	44	8.19	0.36	.792
2. Proprietors, Managers, Officials	1.86 (0.15)	0.241 (2.91)**	-0.010 (1.45)	-0.016 (2.19)*	0.0053 (1.61)	0.0092 (2.21)*	0.0044 (3.02)		44	2.45	0.23	.637
	2.21 (0.15)	0.251 (2.97)**	-0.0093 (1.29)	-0.014 (1.82)+	0.0048 (1.41)	0.0097 (2.28)*	0.0044 (3.00)**	0.921 (8.50)**	44	7.62	0.40	.879
3. Clerks and Kindred Workers	2.11 (0.17)	0.244 (2.52)*	-0.018 (2.13)*	-0.020 (2.60)*	0.0067 (1.93)+	0.0099 (2.07)*	0.0036 (2.19)*		44	2.34	0.21	.444
	2.13 (0.17)	0.245 (2.32)*	-0.018 (2.06)*	-0.020 (2.56)*	0.0067 (1.90)+	0.0099 (2.16)*	0.0036 (2.03)*	1.00 (8.83)**	44	7.32	0.37	.822
4.and 5 Skilled and Semi-Skilled Workers	2.29 (0.18)	0.104 (0.88)	-0.024 (2.62)*	-0.0020 (0.23)	0.0087 (2.36)*	0.0067 (1.19)	0.0015 (0.77)		43	2.25	0.20	.296
	0.48 (0.17)	-0.045 (0.37)	-0.014 (1.45)	-0.0027 (0.35)	0.0089 (2.59)*	0.0081 (1.53)	0.00047 (0.24)	1.341 (9.84)**	43	6.98	0.37	.829

Continued next page.

Table 2. (Continued)

Socio-Economic Group (Occupation of Family Breadwinner)	Inter-cept	Index of Occupa-tion	Teacher-Pupil Ratio	Per Pupil Expendi-ture on Books and Supplies	Teacher Salary Top Decile	Value of School Property Per Pupil	Per Pupil Expenditure on Princi-pals and Supervisors	Fourth Grade Score	N	$\bar{m}$	$\bar{s}$	R^{2b}
6. Unskilled Workers and Servants	2.01 (0.20)	0.358 (2.72)**	-0.018 (1.81)÷	-0.017 (2.02)÷	0.0056 (1.13)	-0.0031 (0.51)	0.0068 (2.51)*		43	2.17	0.23	.370
	1.20 (0.20)	0.256 (1.70)	-0.015 (1.43)	-0.018 (2.21)*	0.0069 (1.37)	-0.0032 (0.54)	0.0058 (2.07)*	1.172 (9.18)**	43	6.68	0.37	.834
All Pupils	1.91 (0.16)	0.255 (3.24)**	-0.021 (1.72)÷	-0.0071 (1.02)	0.0050 (1.54)	0.0040 (0.94)	0.0050 (3.21)**		46	2.38	0.21	.551
	2.62 (0.15)	0.340 (3.45)**	-0.015 (2.01)÷	-0.0026 (0.35)	0.0051 (1.57)	0.0030 (0.71)	0.0048 (3.12)**	0.844 (7.61)**	46	7.45	0.49	.908
$\bar{m}^c$		1.70 Categories (0-5)	42.90 Per 1000 Pupils	12.80 $	78.16 $ (100's)	20.92 $ (100's)	35.82 $	5.07 Standard Grades				
$\bar{s}$		0.46	4.66	4.42	10.48	7.39	15.88	0.34				

Statistical Significance: ÷ indicates significance at the ten percent level, * indicates significance at the five percent level, and ** indicates significance at the one percent level.

[b] Corrected for degrees of freedom lost.

[c] For the school districts represented in the "all pupils" grouping.

General description of the tables is to be found on page 34.

difference in the two regressions is that in the second one for each grouping fourth grade average achievement performance is entered as one of the explanatory variables. This latter procedure is meant to deal with the possibility of pupil mobility. It restricts the analysis to two years of school effects. If there is little pupil mobility between schools the first equation is the better model, since it admits six years of school effects, not just two. In the findings results from both variations were quite similar.

A careful study of Table 2 shows the school input variables divided into two distinct groups. In the first are teacher-pupil ratio and expenditure per pupil on books and supplies, and these variables are negatively related to pupil performance, often at advanced levels of statistical significance. The second group includes the school inputs which appear to be the important inputs to quality education, at least judging from the urban school districts in the first Quality Measurement Project sample. The consistently most important positive school input in the sample is expenditure per pupil on principals and supervisors, with the teacher salary variable second in importance. These relationships emphasize the importance of resources spent on supervision. This finding is similar to one made by Turner who found in an intensive study of teachers in Indiana that only districts with well-developed supervisory staffs were able to effect teacher behavior in desired ways.*

The findings in Table 2 most in need of explanation are those for the two negative variables. Of these the books variable-- with an average expenditure of only about three percent of current expenditures ($14 per pupil)--is relatively insignificant in terms of resource use. The books relationship is puzzeling none-the-less. Perhaps the figure would more properly have been averaged over a period of years rather than taken from just one year. A possible explanation might also be that school districts without the wherewithal to maintain high quality otherwise, compensate somewhat by spending more on books and supplies.

Perhaps the most interesting finding from the 1958 data is that with respect to the consistent and significant negative relationship of teacher-pupil ratio to performance. Perhaps the most logical explanation for such a finding is provided by some research done by Vincent, et.al. several years ago.** In a study of 132 school districts, these authors conclude that in all but the poorest and richest school districts teacher-pupil ratio and salary policy are competing resources and that, when confronted with the hard choice between them, school administrators opt for salary at the expense of teacher-pupil ratio. These findings are consistent with this explanation. It would seem that within limits paying higher salaries buys more quality than lowering pupil-teacher ratios.

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*Richard L. Turner, Differential Association of Elementary Teacher Characteristics with School System Types, Final Report, Project 2579, U.S. Office of Education, (September, 1968).

**William S. Vincent, Bernard H. McKenna, and Austin D. Swanson, "The Question of Class Size," Research Bulletin, Institute of Administrative Research, Teachers College, Columbia University, 1, No. 1, (October, 1960).

A few other generalizations are possible from the regressions in Table 2. Since both the index of occupation and school variables are consistently related to pupil performance, it would seem that both school and community factors are important to the educational process. Several generalizations are possible, also, concerning the differential impact of school variables on pupils from differing socio-economic levels. Most striking is the fact that the supervision variable is very highly related to the performance of pupils from the highest and lowest occupational backgrounds, especially the former. The other two important school inputs are however more consistently related to the middle of the socio-economic spectrum. Thus, except for supervision, the sample schools seemed to serve best the needs of middle class children. Finally, the index of occupation becomes consistently more significant as occupation level goes from high to low. The implication of this is plain; peer group and other socio-economic school influences are most important for children from poor socio-economic background.

The findings from the first New York study just discussed can be summarized into the following points, which serve as starting points for hypotheses to test in the second set of New York schools being examined here.

1. The multiple-regression model lacks explanatory power for the rural and village school districts in the study.

2. Teacher-pupil ratio is consistently related to pupil performance negatively. One explanation for this is that educators within limits sacrifice class size for salary level.

3. The most consistently important school variable is expenditure on supervision, although the salary variable is as important for the middle-class socio-economic groups.

4. Both school inputs and socio-economic factors were found to be highly related to pupil performance.

5. Expenditure on supervisior personnel is most highly related to pupils from the highest and lowest occupational backgrounds--especially the highest. Salary and value of school district property are more highly related to the performance of children from middle-class homes.

6. The socio-economic index was most related to the performance of children from lower socio-economic homes.

II

ANALYSIS OF THE 1965 DATA

The 1965 School Sample

In 1965, personnel of the Division of Evaluation (which had obsorbed the original Quality Measurement Project personnel) gathered test score data for a second sample representing somewhat more than 10% of the 801 school districts which operated schools in the 1964-1965 school year. This time pupil performance and socio-economic data were gathered for grades 5 and 8 for the 1964-1965 school year only; there is no longitudinal aspect to the performance data in the sample. A number of other school district characteristic variables were also gathered by project staff, although the number of such items gathered was much less than for the first study. It was possible to circumvent this deficiency with the use of data gathered by the Basic Educational Data System (BEDS) which began collecting detailed data on New York schools in 1967.

Criteria were somewhat different for the design of the two samples, although in neither case can it be claimed that the sample was selected using purely random procedures, although ex post checks have revealed each to be reasonably representative of New York state (neglecting the city of New York.) The 1958 sample was shown to underrepresent small school districts somewhat, however, and in designing the 1964 sample, some attention was given to including a greater percentage of school districts with average daily attendance in the 500 to 2500 range.* It is to be recalled that it was precisely the small districts in the 1958 sample which displayed highly random behavior patterns.

In the 1958 sample the priority consideration in sample design was whether the school district seemed willing to cooperate with the state over the three year period of the study. This criterion could have imparted sample bias, obviously, although the spirit of cooperation seems to exist in most New York state districts. In the 1964 sample the priority consideration was whether the school district used the Iowa Tests of Basic Skills in Grades 5 and 8. A large number of school districts (about 15%) were found to use the test and it was from this list that the sample was picked. It is to be emphasized that both samples were hand chosen and therefore not random, but the criterion used in selection was that they be as representative of the state as possible. While such a procedure admits the possibility of slight sample bias, both samples were a large enough percentage of the population to insure that they are quite representative of the state.

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*In 1958, 71% of New York school districts had an average daily attendance of less than 2000 pupils and the 1958 sample had a corresponding percentage of 52%. In 1964 the percentage of school districts with less than 2000 pupils was about 64 and in the 1965 sample the figure is about 62%, almost exactly the same.

To be more specific about the 1964 data set, information gathered by project personnel included individual pupil records for pupils in grades 5 and 8 in the 1964 school year with included scores on the Iowa tests and data concerning father's occupation and father's and mother's education. Intelligence test scores were also gathered although with many missing observations. No other data were specifically gathered by project personnel although considerable information is available from regular published reports; variables such as average daily attendance and expenditure per pupil for various purposes were obtained in this way. It should be noted that a record was made of the individual school building attended by each pupil in the district, an important feature for our purposes, since one goal of the study has to examine some school input-output relationships by school building.

The remainder of the data used in this investigation was obtained from the BEDS data, which includes detailed information concerning characteristics of schools, teachers, and administrators which can be identified by school building as well as by school district. Unfortunately from the standpoint of the present study the system did not begin to operate until the 1967 school year, which means there is a three-year lag in variables taken from BEDS. Since the 1967-1968 data came from the first year of a major new undertaking, there were undoubtedly some lapses in quality of data compared to that of subsequent years. This manifested itself in relatively large numbers of missing and incorrectly entered data for some variables, especially those having to do with school physical facilities of the large number of items collected by BEDS, the following were summarized by school building and school district for use in the study:

Variables From BEDS

Teacher salary for regular duties

Number years teacher experience

Teacher degree level

Teacher certification status

Relationship of number of pupils to various school facilities of which number of classrooms, number laboratories, and number of academic classrooms were most important

Value of school district owned property per pupil

Salary of non-classroom professionals

Number of years experience, principals

Degree level of principals.

From these data we constructed variables for teacher-pupil ratio and ratio of teachers and pupils to classroom facilities. Finally, a few other variables, such as population density, were available from other sources. It should be noted that teacher data seemed much more complete than that for non-classroom professionals and the latter information was little used in the study.

Explanatory Models Used With the 1965 Data

Model construction for the later data set proceeded in the fashion similar to that in the earlier study and the models used are subject to essentially the same limitations as those described above for the earlier model. Three models were used for the analysis for school districts and one--much simpler--for school buildings. It will be convenient to give the findings for the school district analysis first and therefore only the three models for that analysis will be discussed in this section.

One of the primary criteria used for model construction in the present study has been the desire to test for replicability of the earlier findings. The first model constructed was therefore one which closely resembled the model used with the 1958 data. Doing this immediately conjured up serious data problems however, since a value variable was only available for 68 of the 86 usable school districts. Instead of limiting the entire analysis to 68 districts, it was decided to discard the value variable and to substitute teacher variables which seemed to be either theoretically important or often related to pupil performance in preliminary multiple regression analysis. The following explanatory model was obtained as the central vehicle for the school district analysis:

$$Y = b_1 + b_2E_m + b_3T_c + b_4T_d + b_5T_e + b_6T_s + b_7R + b_8E_{x_a} + U$$

where:

Y = Achievement score in basic subjects summarized in stratified form according to 7 occupation and educational levels of the pupils' fathers.

E_m = Average education level of mothers' of pupils in the school district.

T_c = Teacher certification level.

T_d = Teacher degree status.

T_e = Average number of years teacher experience.

T_s = Average teacher salary.

R = Pupil-teacher ratio.

Ex_a = Expenditure on central administration per pupil.

U = Unexplained variance.

Together the school variables in this model account for a large percentage of the resources used by most school districts, the obvious exception being the value variable. The mother-education variable is meant to capture effects upon educational quality forthcoming because of the educational "climate" present in the school district, in analagous fashion to the index of father occupation variable used in the earlier model. Any of the three socio-economic background variables could have been used to construct this "climate" variable of course. Mother education was selected because of the assumed closer contact with the day-to-day rearing of children. The education and occupation levels for fathers were used for the stratification purposes, however, on the grounds that overall socio-economic status is more related to the position of the family principal breadwinner.

Of the remaining six variables in the model, three are basically descriptions of the quantity of resources used for various objects. These include average teacher salary, pupil-teacher ratio, and expenditure per pupil on central administration.* The remaining three variables are meant to be proxies for aspects of teacher quality, or perhaps more accurately, for outward manifestations of teacher quality as often perceived by leaders in the public education establishment. The first of these is teacher certification level, of which there are four possible in New York state: None, five-year provisional, ten-year provisional, and fully certified. Certification has to do with the preparation possessed by the teacher in the subject areas she teaches. A fully-certified teacher has adequate preparation (according to state standards) in all subjects she is teaching while the provisional certification means that she is deficient in varying degrees from having the number of course hours of preparation in one or more of her subjects.** The second quality proxy is teacher degree status, of which there are four levels: no B.A., B.A., M.A., and Ph.D., of which only the second and third are meaningful in most instances. As constructed in this way the variable lacks precision. Often the distinction is not only made by degree level but also by number of hours past a given degree level as "Bachelors plus 30 hours" etc. With this information this variable would have been far better. Even so, however, educators often feel that the percentage of teachers who have the masters degree is often a meaningful figure. A more immediate reason was available for including the degree variable in the model however; the variable was found to be related to pupil performance more than any other teacher variable in a study of the 1958 data made by Quality Measurement personnel.*** The third teacher quality proxy used is level of teacher experience. Little needs be said about the theoretical foundations of this variable. To some extent "practice makes perfect" in all lines of endeavor. Many school administrators seem to consider experience as being quite important. It is the biggest single determinant of teacher salary levels. Some researchers have found in recent years however that beyond a certain level, (perhaps coming fairly early in the career), additional teacher experience is not associated with increased pupil performance.* This becomes an important hypothesis to test in the present study.

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*Actually this description of the teacher salary variable is far too simple since salary is very closely related to teacher experience, certification and degree levels. But average teacher salary does represent a most important school resource dimension.

**As I understand it, a five-year probationary certification was issued when a teacher needed further work in her major field and a 10-year probationary certificate issued when she needed further work in a secondary field.

***State Education Department Division of Evaluation, Bureau of School Programs Evaluation, Teacher Characteristics Study, mimeo, Albany, 1968.

It must be emphasized that these "quality" variables are only rather indirect proxies for true teacher attributes. They give no direct information concerning teacher ability inside the classroom, or even of teacher intelligence. Any number of better variables suggest themselves for measuring teacher (and also, incidently, administrator) quality but these are the best possible with available data. Obviously the investigator will not construct precise educational production functions with variables such as these. As variables which have policy relevance, however, the three quality proxies are less bad, since these are characteristics which have been assumed to be important by educational decision makers. As the model stands important policy hypotheses can be tested. To summarize then in question form: Are these teacher preparation characteristics which seem to be highly valued by most educationa leaders in fact related to pupil performance if socio-economic factors are controlled?

Findings: Principal Model

The model just described was fitted to the achievement performance of pupils in seven occupational and educational groupings for grades 5 and 8 for two of the individual Iowa Test Scores (language and arithmetic) plus composite score. The fitted regressions are shown in Tables 3-14. Relationships in the 1964 data are reasonably similar to those in the earlier data, although more are some rather remarkable exceptions to this. For example, in the 1965 regressions average teacher salary is consistently unrelated to pupil performance. Two variables show importance similar to corresponding variables in the earlier study: The socio-economic school variables and administrative expenditure per pupil. Even here there are some differences however. The SE variable is generally more related to the progress of children from higher socio-economic levels and the administrative resource variable more related to the performance of children from the middle of the socio-economic spectrum, whereas in the earlier study administrative resource inputs were more highly related to the progress of children from the highest and lowest socio-economic levels. These differences are however more marked when the stratification criterion is education as opposed to occupation. This is to be expected, since occupation was the stratification criterion in the earlier study.

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*The works cited above by Katzman and Turner both found this phenomenon.

Table 3

Fitted Multiple Regression Equations,
Language Performance, Grade 5, Iowa Tests of Basic Skills

Father's Education Level	Intercept	Mothers' Education Level	Teacher Certification Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. 4 or More Years of College	6.541 (0.339)	-0.295 (2.75)**	0.537 (1.53)	-0.316 (0.96)	0.036 (2.16)*	-0.013 (1.45)	-0.018 (1.17)	0.055 (1.14)	85	6.37	0.38	.266
2. 1-3 Years of College	4.992 (0.380)	-0.335 (2.52)*	0.764 (1.91)+	-0.803 (2.12)*	0.0096 (0.50)	0.0016 (0.16)	0.0010 (0.06)	0.112 (1.80)+	85	5.88	0.44	.313
3. High School Graduate	3.884 (0.292)	-0.077 (0.74)	0.846 (3.06)**	-0.400 (1.49)	0.0050 (0.36)	-0.0061 (0.77)	-0.012 (1.01)	0.106 (2.54)*	86	5.53	0.33	.278
4. Completed at Least Grade 10; No High School Diploma	3.523 (0.342)	-0.182 (1.45)	0.662 (2.20)*	-0.505 (1.61)	0.0058 (0.39)	0.0026 (0.28)	0.0059 (0.42)	0.149 (2.76)**	86	5.15	0.37	.240
5. 7-9 Years of Schooling	4.007 (0.365)	-0.263 (1.92)+	0.272 (0.94)	-0.182 (0.58)	0.017 (1.11)	0.0035 (0.35)	0.0048 (0.33)	0.108 (2.09)*	86	4.81	0.37	.155
6. 1-6 Years of Schooling	3.605 (0.495)	-0.187 (0.91)	1.187 (2.25)*	-0.417 (0.79)	-0.042 (1.71)+	-0.015 (0.92)	-0.027 (0.95)	0.079 (0.97)	74	4.45	0.49	.116
7. No Formal Schooling	Not Computed.											

Note : Same notes as for p.32.

Table 4

Fitted Multiple Regression Equations,
Mathematics Performance, Grade 5, Iowa Tests of Basic Skills

Father's Educational Level	Intercept	Mothers' Education Level	Teacher Certification Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. 4 or More Years of College	5.567 (0.278)	-0.357 (4.07)**	0.593 (2.06)*	0.213 (0.79)	0.036 (2.62)*	-0.027 (3.48)**	-0.0071 (0.57)	0.075 (1.91)+	86	5.79	0.34	.395
2. 1-3 Years of College	5.270 (0.273)	-0.325 (3.40)**	0.531 (1.85)+	-0.068 (0.25)	0.034 (2.49)*	-0.014 (1.88)+	-0.014 (1.12)	0.035 (0.78)	85	5.44	0.33	.389
3. High School Graduate	4.697 (0.254)	-0.129 (1.44)	0.674 (2.81)**	-0.284 (1.21)	0.0096 (0.81)	-0.013 (1.92)+	-0.020 (1.98)+	0.113 (3.11)**	86	5.19	0.29	.317
4. Completed at Least Grade 10; No High School Diploma	3.705 (0.267)	-0.193 (1.96)+	0.755 (3.21)**	-0.326 (1.33)	0.0084 (0.71)	-0.0074 (1.01)	-0.0036 (0.33)	0.102 (2.41)*	86	4.97	0.31	.321
5. 7-9 Years of Schooling	4.519 (0.299)	-0.164 (1.47)	0.138 (0.58)	-0.037 (0.14)	0.019 (1.58)	-0.00021 (0.02)	-0.0078 (0.67)	0.051 (1.20)	86	4.75	0.30	.123
6. 1-6 Years of Schooling	0.898 (0.386)	-0.098 (0.61)	1.257 (3.05)**	-0.053 (0.13)	-0.055 (2.87)**	-0.0018 (0.14)	0.0031 (0.13)	0.075 (1.18)	74	4.46	0.40	.189
7. No Formal Schooling	Not Computed.											

Note: Same notes as for p. 32.

Table 5

Fitted Multiple Regression Equations
Composite Performance, Grade 5, Iowa Tests of Basic Skills

Father's Education Level	Intercept	Mother Education Level	Teacher Certification Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. 4 or More Years of College	5.840 (0.327)	-0.468 (4.54)**	0.594 (1.75)+	0.144 (0.45)	0.034 (2.10)*	-0.022 (2.50)*	-0.0038 (0.26)	0.078 (1.69)+	85	6.08	0.40	.398
2. 1-3 Years of College	5.144 (0.327)	-0.533 (4.67)**	0.833 (2.43)*	-0.366 (1.13)	0.024 (1.47)	-0.012 (1.36)	-0.012 (0.79)	0.117 (2.19)*	85	5.59	0.43	.380
3. High School Graduate	3.811 (0.287)	-0.202 (1.99)*	0.972 (3.58)**	-0.340 (1.28)	0.0015 (0.11)	-0.013 (1.67)+	-0.0095 (0.84)	0.138 (3.36)**	86	5.28	0.34	.352
4. 10-11+ Years of Schooling	3.827 (0.329)	-0.409 (3.37)**	0.850 (2.93)**	0.223 (0.74)	0.012 (0.80)	-0.014 (1.61)	0.0044 (0.32)	0.175 (3.38)**	86	4.93	0.39	.362
5. 7-9 Years of Schooling	4.264 (0.336)	-0.424 (3.36)**	0.339 (1.28)	0.00014 (0.00)	0.024 (1.71)+	-0.0068 (0.74)	0.0038 (0.29)	0.148 (3.13)**	86	4.66	0.37	.258
6. 1-6 Years of Schooling	3.621 (0.462)	-0.344 (1.79)+	1.037 (2.09)*	-0.428 (0.86)	-0.040 (1.75)+	-0.020 (1.29)	0.022 (0.80)	0.134 (1.75)+	74	4.26	0.47	.166
7. No Formal Schooling	Not Computed.											

Notes: See page 34.

Table 6

Fitted Multiple Regression Equations,
Language Performance, Grade 8, Iowa Tests of Basic Skills

Fathers' Education Level	Intercept	Mothers' Education Level	Teacher Certification Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. 4 or More Years of College	10.081 (0.417)	-0.367 (2.74)**	-0.066 (0.15)	0.494 (1.17)	0.057 (2.67)**	-0.016 (1.42)	0.0055 (0.29)	-0.085 (1.40)	82	9.47	0.45	.219
2. 1-3 Years of College	11.059 (0.484)	-0.530 (3.14)**	-0.414 (0.83)	0.412 (0.86)	0.052 (2.02)*	-0.016 (1.22)	-0.013 (0.57)	0.127 (1.70)+	84	8.65	0.51	.181
3. High School Graduate	9.724 (0.405)	-0.218 (1.49)	-0.169 (0.45)	-0.612 (1.61)	0.037 (1.92)+	0.0051 (0.49)	-0.00084 (0.05)	0.055 (0.92)	86	8.32	0.42	.161
4. Completed at Least Grade 10; No High School Diploma	6.670 (0.486)	-0.124 (0.71)	0.190 (0.45)	-0.464 (1.02)	0.0046 (0.21)	0.017 (1.31)	0.0084 (0.43)	0.028 (0.36)	86	7.77	0.48	.068
5. 7-9 Years of Schooling	6.806 (0.563)	-0.216 (1.01)	-0.179 (0.39)	-0.247 (0.51)	0.018 (0.77)	0.017 (1.01)	0.024 (1.16)	0.090 (1.14)	86	7.39	0.55	.068
6. 1-6 Years of Schooling	7.025 (0.858)	-0.660 (1.92)+	0.654 (0.66)	0.689 (0.69)	-0.0058 (0.12)	-0.014 (0.45)	-0.064 (1.45)	0.098 (0.61)	68	7.04	0.86	.119
7. No Formal Schooling	7.998 (0.908)	-1.563 (1.72)	-4.666 (1.64)	5.242 (2.48)*	0.213 (1.50)	0.099 (1.02)	-0.077 (0.77)	-0.209 (0.54)	18	6.93	1.08	.611

Notes: See page 34.

Table 7

Fitted Multiple Regression Equations,
Mathematics Performance, Grade 8, Iowa Tests of Basic Skills

Fathers' Education Level	Intercept	Mothers' Education Level	Certification Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. 4 or More Years of College	11.640 (0.392)	-0.294 (2.33)*	-0.402 (0.98)	-0.511 (1.29)	0.035 (1.75)+	0.0048 (0.45)	-0.0011 (0.06)	-0.084 (1.47)	82	9.13	0.40	.149
2. 1-3 Years of College	7.544 (0.420)	-0.091 (0.62)	0.234 (0.54)	0.037 (0.09)	0.012 (0.55)	0.0050 (0.44)	-0.013 (0.66)	0.019 (0.29)	84	8.63	0.41	.065
3. High School Graduate	9.314 (0.407)	-0.113 (0.77)	-0.262 (0.70)	-0.525 (1.37)	0.027 (1.42)	0.0094 (0.89)	0.0022 (0.13)	0.095 (1.58)	86	8.33	0.41	.119
4. Completed at Least Grade 10; No High School Diploma	8.123 (0.413)	-0.154 (1.04)	0.212 (0.58)	-0.359 (0.9[illegible])	0.0011 (0.06)	-0.0014 (0.13)	-0.00081 (0.05)	0.129 (2.00)*	86	7.94	0.41	.080
5. 7-9 Years of Schooling	7.929 (0.488)	-0.219 (1.18)	-0.261 (0.65)	-0.155 (0.37)	0.039 (1.87)+	0.0044 (0.30)	0.016 (0.89)	0.154 (2.25)*	86	7.62	0.50	.139
6. 1-6 Years of Schooling	5.046 (0.759)	-0.557 (1.83)*	1.203 (1.38)	-0.657 (0.75)	-0.038 (0.88)	0.018 (0.65)	-0.021 (0.54)	0.077 (0.54)	68	7.40	0.76	.132
7. No Formal Schooling	-7.669 (0.780)	-1.431 (1.83)+	1.544 (0.63)	5.224 (2.88)**	0.050 (0.41)	0.026 (0.31)	-0.093 (1.09)	0.404 (1.22)	18	6.96	0.92	.602

Notes: See page 34.

Table 8

Fitted Multiple Regression Equations,
Composite Performance, Grade 8, Iowa Tests of Basic Skills

Fathers' Education Level	Intercept	Mothers' Education Level	Teacher Certification Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. 4 or More Years of College	9.876 (0.424)	-0.623 (4.59)**	-0.169 (0.38)	0.443 (1.04)	0.057 (2.65)**	-0.0091 (0.78)	0.023 (1.20)	-0.055 (0.89)	82	9.26	0.49	.333
2. 1-3 Years of College	8.398 (0.433)	-0.501 (3.32)**	0.297 (0.67)	0.345 (0.80)	0.018 (0.80)	-0.019 (1.64)	0.018 (0.89)	0.177 (2.67)**	84	8.53	0.48	.277
3. High School Graduate	8.318 (0.420)	-0.292 (1.92)+	-0.089 (0.23)	-0.143 (0.36)	0.039 (1.96)+	-0.0045 (0.41)	0.038 (2.26)*	0.130 (2.10)*	86	8.17	0.44	.188
4. Completed at Least Grade 10; No High School Diploma	4.899 (0.507)	-0.283 (1.56)	0.620 (1.39)	-0.382 (0.81)	0.0040 (0.17)	0.0095 (0.69)	0.036 (1.77)+	0.210 (2.64)**	86	7.64	0.54	.198
5. 7-9 Years of Schooling	5.094 (0.696)	-0.216 (0.81)	-0.124 (0.22)	0.180 (0.30)	0.025 (0.84)	0.0088 (0.41)	0.059 (2.30)*	0.274 (2.81)**	86	7.21	0.71	.139
6. 1-6 Years of Schooling	3.440 (0.856)	-0.555 (1.62)	1.095 (1.11)	-0.396 (0.40)	-0.032 (0.67)	0.024 (0.80)	-0.015 (0.35)	0.229 (1.43)	68	6.97	0.86	.134
7. No Formal Schooling	-10.487 (0.914)	-1.574 (1.72)	1.639 (0.57)	5.429 (2.55)*	0.021 (0.15)	0.052 (0.54)	-0.052 (0.52)	0.214 (0.55)	18	6.82	1.02	.558

Notes: See page 34.

Table 9

Fitted Multiple Regression Equations
Language Performance, Grade 5, Iowa Tests of Basic Skills

Father's Occupation Level	Inter-cept	Mother's Education Level	Teacher Certi-fication Level	Teacher Degree Status	Teacher Exper-ience	Average Teacher Salary	Pupil-Teacher Ratio	Adminis-trative Expendi-ture Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. Professional Persons	9.392 (0.380)	-0.330 (2.63)*	-0.302 (0.69)	-0.557 (1.39)	0.042 (2.00)*	-0.0083 (0.73)	0.00051 (0.03)	0.110 (1.84)+	78	6.53	0.40	.207
2. Proprietors, Managers, Officials	5.722 (0.409)	-0.184 (1.36)	0.533 (1.36)	-0.067 (0.18)	0.024 (1.28)	-0.0088 (0.79)	-0.031 (1.65)	0.017 (0.33)	82	6.19	0.42	.140
3. Clerks and Kindred Workers	3.156 (0.440)	-0.112 (0.73)	1.130 (2.26)*	-0.117 (0.26)	-0.00003 (0.0011)	-0.0071 (0.61)	-0.017 (0.87)	0.00077 (0.011)	79	5.91	0.46	.162
4. Skilled Workers and Foremen	2.950 (0.422)	-0.131 (0.92)	0.831 (1.95)+	0.019 (0.04)	0.016 (0.72)	-0.0068 (0.63)	-0.0040 (0.21)	0.145 (2.34)*	85	5.58	0.45	.205
5. Semi-Skilled Workers	3.420 (0.294)	-0.122 (1.18)	0.863 (3.24)**	-0.577 (2.09)*	-0.0036 (0.26)	0.0022 (0.27)	-0.0021 (0.18)	0.117 (2.70)**	86	5.42	0.34	.306
6. Other Laborers	3.937 (0.993)	-0.359 (0.83)	0.483 (0.51)	0.804 (0.81)	0.051 (1.06)	-0.026 (0.82)	-0.038 (0.82)	0.343 (2.02)*	77	5.01	0.99	.094
7. Servant Classes	13.887 (5.727)	-5.652 (1.70)+	4.910 (0.50)	-0.368 (0.05)	0.544 (1.23)	-0.199 (0.95)	-0.347 (1.07)	2.453 (2.24)*	52	6.45	6.22	.283

Notes: See page 34.

Table 10

Fitted Multiple Regression Equations,
Mathematics Performance, Grade 5, Iowa Tests of Basic Skills

Father's Occupation Level	Intercept	Mother's Education Level	Teacher Certification Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. Professional Persons	6.358 (0.343)	-0.321 (2.83)**	0.310 (0.78)	0.228 (0.63)	0.042 (2.20)*	-0.029 (2.84)**	0.0067 (0.41)	0.124 (2.29)*	78	5.89	0.39	.296
2. Proprietors, Managers, Officials	6.064 (0.344)	-0.314 (2.75)**	0.378 (1.15)	0.210 (0.66)	0.034 (2.20)*	-0.021 (2.29)*	-0.022 (1.39)	0.056 (1.25)	82	5.66	0.37	.225
3. Clerks and Kindred Workers	3.176 (0.307)	-0.122 (1.14)	1.045 (2.99)**	0.314 (1.01)	0.019 (1.12)	-0.021 (2.55)*	-0.028 (2.04)*	0.033 (0.68)	79	5.46	0.35	.320
4. Skilled Workers and Foremen	3.697 (0.343)	-0.165 (1.42)	0.607 (1.75)+	-0.155 (0.44)	0.019 (1.10)	-0.0031 (0.35)	-0.0087 (0.56)	0.088 (1.75)+	85	5.23	0.37	.219
5. Semi-Skilled Workers	4.669 (0.230)	-0.165 (2.05)*	0.714 (3.42)**	-0.455 (2.11)*	-0.0012 (0.11)	-0.0082 (1.32)	-0.014 (1.54)	0.065 (1.90)+	86	5.14	0.27	.331
6. Other Laborers	4.263 (1.062)	-0.327 (0.71)	0.345 (0.34)	1.148 (1.08)	0.059 (1.14)	-0.038 (1.14)	-0.031 (0.62)	0.338 (1.87)+	77	4.87	1.05	.083
7. Servant Classes	19.180 (5.945)	-5.951 (1.72)+	5.161 (0.51)	-0.850 (0.12)	0.518 (1.13)	-0.233 (1.07)	-0.415 (1.23)	2.442 (2.14)	52	6.59	6.44	.279

Notes: See page 34.

Table 11
Fitted Multiple Regression Equations, Composite Performance, Grade 5, Iowa Tests of Basic Skills

	Fathers' Occupation Level	Intercept	Mother's Education Level	Teacher Certification Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1.	Professional Persons	6.520 (0.403)	-0.457 (3.44)**	0.389 (0.84)	-0.067 (0.16)	0.035 (1.59)	-0.020 (1.70)÷	0.014 (0.76)	0.117 (1.84)÷	78	6.21	0.46	.305
2.	Proprietors, Managers Officials	5.286 (0.378)	-0.262 (2.09)*	0.435 (1.21)	0.325 (0.94)	0.018 (1.08)	-0.015 (1.45)	-0.016 (0.95)	0.072 (1.45)	82	5.90	0.40	.192
3.	Clerks and Kindred Workers	2.497 (0.399)	-0.290 (2.10)*	1.52 (3.45)**	0.082 (0.20)	0.0019 (0.085)	-0.023 (2.18)*	-0.0084 (0.46)	0.0045 (0.07)	79	5.60	0.46	.318
4.	Skilled Workers and Foremen	3.087 (0.371)	-0.330 (2.63)*	1.014 (2.70)**	-0.186 (0.49)	0.014 (0.76)	-0.011 (1.12)	0.0033 (0.20)	0.139 (2.57)*	85	5.34	0.43	.344
5.	Semi-Skilled Workers	4.298 (0.263)	-0.354 (3.85)**	0.864 (3.63)**	-0.383 (1.55)	-0.00081 (0.06)	-0.010 (1.45)	-0.0053 (0.51)	0.125 (3.23)**	86	5.17	0.33	.423
6.	Other Laborers	4.220 (1.024)	-0.457 (1.02)	0.547 (0.56)	1.056 (1.03)	0.055 (1.10)	-0.041 (1.27)	-0.034 (0.70)	0.389 (2.22)*	77	4.82	1.03	.111
7.	Servant Classes	15.791 (5.999)	-6.341 (1.82)÷	5.678 (0.56)	-0.740 (0.10)	0.518 (0.12)	-0.227 (1.03)	-0.347 (1.02)	2.564 (2.23)*	52	6.40	6.50	.280

Notes: See page 34.

Table 12
Fitted Multiple Regression Equations,
Language Performance, Grade 8, Iowa Tests of Basic Skills

Fathers' Occupation Level	Inter-cept	Mothers' Education Level	Teacher Certi-fication Level	Teacher Degree Status	Teacher Exper-ience	Average Teacher Salary	Pupil-Teacher Ratio	Adminis-trative Expendi-ture Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. Professional Persons	9.813 (0.506)	-0.465 (2.74)**	-0.245 (0.42)	0.615 (1.08)	0.073 (2.46)*	-0.010 (0.69)	0.0049 (0.20)	0.022 (0.28)	75	9.51	0.54	.212
2. Proprietors, Managers, Officials	10.203 (0.508)	-0.181 (1.10)	-0.090 (0.19)	0.00089 (0.002)	0.057 (2.32)*	-0.020 (1.55)	0.025 (1.16)	0.024 (0.38)	85	9.12	0.53	.159
3. Clerks and Kindred Workers	11.683 (0.458)	-0.695 (4.17)**	-0.851 (1.76)+	0.137 (0.28)	0.087 (3.34)**	0.014 (1.06)	-0.044 (1.97)+	-0.024 (0.32)	74	8.70	0.54	.349
4. Skilled Workers and Foremen	9.605 (0.685)	-0.362 (1.42)	-0.415 (0.64)	0.456 (0.67)	0.064 (1.90)+	-0.010 (0.56)	-0.0031 (0.097)	0.089 (0.83)	83	8.33	0.67	.070
5. Semi-Skilled Workers	9.802 (0.406)	-0.285 (2.04)*	-0.240 (0.70)	-0.496 (1.30)	0.018 (0.98)	0.0059 (0.54)	0.0078 (0.49)	-0.029 (0.46)	86	8.06	0.41	.101
6. Other Laborers	0.051 (1.297)	0.022 (0.04)	0.584 (0.46)	0.360 (0.27)	0.070 (1.06)	0.053 (1.19)	-0.066 (1.10)	0.501 (2.24)*	73	7.69	1.32	.147
7. Servant Classes	-19.291 (4.13)	-1.318 (0.57)	10.649 (1.13)	-3.352 (0.50)	-0.034 (0.09)	0.075 (0.32)	-0.446 (1.93)+	1.158 (1.17)	36	7.93	4.22	.252

Notes: See page 34.

Table 13

Fitted Multiple Regression Equations,
Mathematics Performance, Grade 8, Iowa Tests of Basic Skills

Fathers' Occupation Level	Intercept	Mothers' Education Level	Teacher Certification Level	Teacher Degree Sratus	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	N	m	s	R^2
1. Professional Persons	11.299 (0.454)	-0.229 (1.50)	-0.760 (1.44)	-0.050 (0.10)	0.026 (0.99)	0.0094 (0.72)	0.012 (0.54)	-0.040 (0.56)	75	9.18	0.44	.058
2. Proprietors, Managers, Officials	10.401 (0.432)	-0.163 (1.16)	0.012 (0.03)	-0.668 (1.61)	0.031 (1.45)	-0.00083 (0.07)	0.00053 (0.03)	-0.044 (0.82)	85	8.93	0.44	.137
3. Clerks and Kindred Workers	10.812 (0.434)	-0.345 (2.19)*	-0.540 (1.17)	-0.115 (0.25)	0.049 (2.01)*	0.016 (1.31)	-0.051 (2.41)*	-0.089 (1.26)	74	8.64	0.47	.229
4. Skilled Workers and Foremen	8.950 (0.536)	-0.269 (1.35)	-0.021 (0.04)	-0.203 (0.38)	0.018 (0.71)	-0.00091 (0.06)	0.011 (0.43)	0.038 (0.46)	83	8.31	0.52	.046
5. Semi-Skilled Workers	8.335 (0.377)	-0.181 (1.39)	-0.155 (0.48)	-0.194 (0.55)	0.019 (1.08)	0.0079 (0.78)	0.0083 (0.57)	0.082 (1.39)	86	8.15	0.37	.084
6. Other Laborers	0.228 (1.645)	-0.038 (0.05)	0.569 (0.35)	0.321 (0.18)	0.115 (1.38)	0.048 (0.85)	-0.072 (0.94)	0.651 (2.29)*	73	7.90	1.67	.142
7. Servant Classes	-19.390 (4.440)	-1.377 (0.56)	11.897 (1.17)	-2.553 (0.35)	0.011 (0.03)	0.0066 (0.03)	-0.501 (2.02)+	1.390 (1.31)	36	8.29	4.58	.268

Notes: See page 34.

Table 14
Fitted Multiple Regression Equations, Composite Performance, Grade 8, Iowa Tests of Basic Skills

Fathers' Occupation Level	Inter-cept	Mothers' Education Level	Certi-fication Level	Teacher Degree Status	Teacher Exper-ience	Average Teacher Salary	Pupil-Teacher Ratio	Adminis-trative Expendi-ture Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. Professional Persons	9.323 (0.525)	-0.701 (3.97)**	-0.549 (0.90)	0.797 (1.34)	0.075 (2.42)*	-0.00019 (0.01)	0.032 (1.26)	0.051 (0.62)	75	9.24	0.61	.344
2. Proprietors, Managers, Officials	9.354 (0.454)	-0.364 (2.47)*	0.138 (0.33)	0.098 (0.22)	0.048 (2.17)*	-0.021 (1.85)+	0.037 (1.91)+	0.032 (0.57)	85	8.98	0.49	.219
3. Clerks and Kindred Workers	10.275 (0.501)	-0.881 (4.84)**	-0.624 (1.18)	0.036 (0.07)	0.083 (2.94)**	0.018 (1.26)	-0.0053 (0.21)	-0.030 (0.37)	74	8.56	0.60	.384
4. Skilled Workers and Foremen	7.799 (0.601)	-0.439 (1.97)+	0.017 (0.03)	0.584 (0.98)	0.048 (1.65)	-0.017 (1.04)	0.024 (0.86)	0.169 (1.81)+	83	8.18	0.61	.601
5. Semi-Skilled Workers	8.013 (0.460)	-0.360 (2.27)*	-0.130 (0.33)	-0.098 (0.22)	0.023 (1.08)	0.00077 (0.06)	0.041 (2.29)*	0.116 (1.63)**	86	7.91	0.47	.151
6. Other Laborers	-2.992 (1.434)	0.031 (0.05)	0.956 (0.67)	0.954 (0.64)	0.066 (0.91)	0.043 (0.88)	-0.027 (0.40)	0.709 (2.86)**	73	7.59	1.48	.168
7. Servant Classes	-31.838 (4.149)	-1.193 (0.52)	13.764 (1.45)	-2.828 (0.42)	-0.169 (0.30)	0.072 (1.62)	-0.376 (1.25)	1.234	36	7.68	4.19	.238

Notes: See page 34.

Explanatory Variables
Used In Tables 3-14 and in Tables 15, 16, 18-23 Below.

Variable	Sample Mean	Sample Standard Deviation	Measurement Units	Number of School Districts for Which Valued Observations Were Available
Mothers' Education Level	2.23	0.33	Educational Categories (7 possible)	86
Teacher Certification Level	3.64	0.18	Categories (4 possible)	86
Teacher Degree Status	2.08	0.14	Categories (4 possible B.A. = 2.0 M.A. = 3.0)	86
Teacher Experience	12.24	3.49	Years	86
Teacher Salary	80.00	4.76	Hundreds of Dollars	86
Pupil-Teacher Ratio	19.21	2.75	Pupils per Teacher	86
Administrative Expenditure	1.99	0.71	Tens of Dollars per Pupil	86
Pupils per Classroom	17.79	5.57	Pupils per Classroom	86
School Property Value	27.67	5.51	Hundreds of Dollars	64
Number of Administrative and Supervisory Personnel	0.98	0.24	Number per 1000 Pupils	64

Descriptions of Tables

Table Format

Given in each table are the computed coefficients of partial regression. The figures in parentheses under each coefficient are the values of the t-statistic. The figure under the intercept is the standard error of the estimate. Values given to the right of each set of partial regression coefficients are the number of observations used in that regression, the sample mean and sample standard deviation of the dependent variable, and the coefficient of multiple determination, correlated for degrees of freedom lost.

(Continued next page.)

Levels of Statistical Significance

The scheme used in these tables to denote statistical significance is as follows:

+	indicates significance at the ten percent level.
*	indicates significance at the five percent level.
**	indicates significance at the one percent level.

Weighting

Since the expected sample variance is greater for averages computed for small groups of pupils as opposed to large, one of the standard assumptions of the classical least squares multiple regression model, that of homoscedasticity or equal expected variance of error terms, is violated. To correct for this a weighting scheme was used in the calculations which is often termed Aitken's Generalized Least Squares. Weighting schemes of this nature may impart some upward bias to calculated coefficients of multiple determination.

The other school input (besides administrative expenditure) which is consistently related to pupil performance is teacher certification level. This is not a little surprising in light of the fact that New York personnel found degree status important but certification level unimportant in a study, already mentioned, of the 1958 data. Another curious aspect of the findings for the certification variable is the fact that the variable is only important at the fifth grade level; in grade eight it is seldom significant and usually has the wrong sign. Why the level of teacher course-work preparation should be highly related to performance of fifth graders and unrelated to that of eighth graders is not at all obvious to the author. The only other teacher variable which seems related to pupil performance is teacher experience, and it is most interesting that this is only true for pupils from good socio-economic backgrounds. In point of fact, the sign of the experience variable quite consistently changes from positive and significant to negative and (sometimes) significant as the socio-economic spectrum is travelled from high to low. No ready explanation for this comes to mind either. It would seem that teacher experience doesn't have much to do with successfully educating children from disadvantaged social backgrounds.

The remaining three school input variables are consistently unrelated to pupil performance. This is especially true with the degree-status and salary variables which seldom have the correct sign. It is note-worthy that teacher-pupil ratio is much less negatively related to pupil performance in the regressions fitted to the 1965 data than the ones fitted to the 1958 data where, as the reader will recall, the variable was often statistically significant with the wrong sign. (The expected sign of this variable for the present study is negative.) There are few significant partial regression coefficients with the wrong sign in the grade 8 regressions however.

Alternate Explanatory Models

1. Adding variables for value and number of supervisory personnel.

Two other explanatory models were constructed. The first ulilized a value variable in order to replicate more closely the model used in the earlier study. One further change was also made. For an administrative resources variable the number of principals and supervisors per 100 pupils was substituted for administrative expenditures per pupil. Both of these variables were only available for 68 school districts. The explanatory variables used for the first alternate model were therefore:

1. Average mother education level
2. Average teacher certification level
3. Average teacher degree status
4. Average number years teacher experience
5. Pupil-teacher ratio

Table 15 *
Fitted Regression Equations:
Alternate Model Using Value of School District Assets.
Per Pupil and Number of Principals and Supervisors per 1000 Pupils, Composite Score, Grade 5

ather's Occupation Level	Inter-cept	Mothers' Education Level	Teacher Certi-fication Level	Teacher Degree Status.	Teacher Exper-ience	Average Teacher Salary	Pupil-Teacher Ratio	Value	Adminis-trative Personnel Per 100 Pupils	N	$\bar{m}$	$\bar{s}$	R^2
1. Professional Persons	7.059 (0.422)	-0.623 (3.51)**	0.404 (0.62)	-0.411 (0.79)	0.0021 (0.07)	-0.0096 (0.41)	0.026 (1.02)	-0.017 (0.91)	0.438 (1.09)	56	6.28	0.47	.311
2. Proprietors, Managers, Officials	6.650 (0.421)	-0.272 (1.68)+	-0.118 (0.26)	0.485 (1.07)	0.0019 (0.07)	0.0076 (0.40)	-0.034 (1.40)	-0.017 (1.08)	-0.272 (0.85)	59	5.95	0.43	.166
3. Clerks and Kindred Workers	3.576 (0.421)	-0.052 (0.33)	0.981 (1.71)+	0.314 (0.63)	-0.034 (1.21)	-0.011 (0.63)	-0.0060 (0.27)	-0.020 (1.23)	0.043 (0.13)	57	5.74	0.43	.196
4. Skilled Workers and Foremen	5.566 (0.407)	-0.251 (1.69)+	0.155 (0.34)	0.411 (0.84)	0.0013 (0.05)	0.0073 (0.47)	-0.027 (1.17)	-0.026 (1.94)+	-0.351 (1.22)	62	5.47	0.43	.216
5. Semi-Skilled Workers	5.149 (0.309)	-0.178 (1.54)	0.517 (1.87)+	-0.359 (1.15)	-0.027 (1.57)	0.0076 (0.66)	-0.012 (0.86)	-0.014 (1.44)	-0.275 (1.31)	63	5.28	0.33	.225
6. Other Laborers	5.678 (1.321)	0.051 (0.08)	-0.709 (0.56)	2.189 (1.48)	-0.0015 (0.02)	0.00005 (0.001)	-0.056 (0.74)	-0.040 (0.95)	-0.525 (0.52)	57	4.94	1.26	.071
7. Servant Classes	62.471 (8.701)	-4.132 (0.74)	0.905 (0.07)	-2.516 (0.21)	0.463 (0.64)	-0.244 (0.68)	-0.927 (1.66)	-0.212 (0.47)	-5.807 (0.76)	35	8.65	8.48	.210

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[*] Through an error regressions were fitted to these populations by occupation level rather than education level. While education level stratifications are preferred on the grounds that education is a somewhat better socio-economic variable for analysis of educational phenomena, these occupation results should be quite similar to those which would have obtained using educational strata. Further notes: see p. 34.

Table 16
Fitted Regression Equations:
Alternate Model Using Value of School District Assets Per Pupil and Number of School Principals and Supervisors per 1000 Pupils, Composite Score, Grade 8

Fathers' Education	Intercept	Mothers' Education Level	Teacher Certification Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Value	Administrative Personnel Per 100 Pupils	N	$\bar{m}$	$\bar{s}$	R^2
1. 4 or More Years of College	9.622 (0.432)	-0.213 (1.28)	-0.669 (1.22)	1.133 (2.28)*	0.012 (0.42)	0.012 (0.61)	0.011 (0.45)	-0.027 (1.51)	-0.239 (0.71)	60	9.45	0.45	.200
2. 1-3 Years of College	10.885 (0.456)	-0.634 (3.69)**	0.257 (0.49)	0.339 (0.68)	0.0063 (0.23)	-0.021 (1.17)	-0.049 (1.87)+	-0.0035 (0.22)	-0.034 (0.10)	61	8.59	0.51	.306
3. High School Graduate	9.729 (0.404)	-0.233 (1.57)	-0.583 (1.54)	0.306 (0.78)	0.0000 (1.44)	0.020 (1.50)	-0.0066 (0.34)	-0.022 (1.73)+	-0.294 (1.11)	63	8.29	0.40	.142
4. 10-11+ Years of Schooling	8.465 (0.491)	0.0085 (0.05)	-0.479 (1.12)	0.282 (0.57)	-0.020 (0.73)	0.027 (1.61)	-0.012 (0.53)	-0.028 (1.98)+	-0.425 (1.31)	63	7.81	0.48	.095
5. 7-9 Years of Schooling	8.370 (0.677)	0.040 (0.15)	-1.180 (2.13)*	0.702 (1.02)	0.012 (0.35)	0.050 (1.90)+	-0.025 (0.88)	-0.043 (2.29)*	-0.763 (1.56)	63	7.36	0.69	.179
6. 1-6 Years of Schooling	10.685 (0.782)	-0.451 (1.32)	-0.569 (0.67)	0.157 (0.15)	-0.067 (1.18)	0.074 (2.28)*	-0.112 (2.22)*	-0.086 (3.27)**	-1.194 (1.91)+	49	7.06	0.88	.354
7. No Formal Schooling	Not Computed.												

Notes: See page 34.

6. Value per pupil of school district owned property

7. Number of principals and assistant principals per 100 pupils

Neither of the two new variables was positively related to pupil performance and for three socio-economic levels in grade 8 the value variable was negative and statistically significant. Indeed, the value variable seems more strongly related negatively to pupil performance for the lower pupil socio-economic levels. The principals variable shows somewhat the same tendency although it is never very significant.

Of these two findings, that for the value variable is the most difficult to explain in light of past findings. The reader will recall that the value of school property variable was often positively related to performance quality in the earlier New York study. This time the conclusion would seem to be that amount of physical plant per pupil (at least considered in value terms) is negatively related to pupil performance, if at all, and that the school districts which possess more value of property to relatively poorer in educating pupils from low SE backgrounds than those with less. While these relationships are not without possible explanations,* we must be completely agnostic concerning the value variable because of the conflicting finding in the earlier study.

The negative relationship for the principals variable is consistent with unpublished findings for relationships in the first Quality Measurement Project sample. In that study the same relationships were found, i.e., expenditure per pupil on administration was positively related to performance while number of principals, assistant principals, and supervisors per 100 pupils were negatively related to performance. This result is itself quite enigmatic. The tentative hypothesis with which the author usually explains the finding in that more supervisory personnel are needed when more disciplinary problems exist. The fact that expenditure on such personnel seems to be inversely related to their numbers would suggest that schools with relatively more principals are paying them less, or else they are devoting resources to other (effective) administrative services besides employment of professional personnel. These relationships are obviously in need of much more investigation.

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*The hypothesis would be that wealthier school districts display an educational orientation which focuses upon the progress of the majority of their student body and relatively neglects the more poorly motivated pupils from low SE backgrounds. It is supported to some extent by the findings in an earlier paper published by the author where expenditure per pupil was negatively (although weakly) related to the progress of pupils from the lowest socio-economic backgrounds. "Measuring a Local Government Service: A Study of School Districts in New York State," Review of Economics and Statistics, Vol. 49, No. 3 (August, 1967), 356-367.

An alternate hypothesis will be explored with the findings from the next explanatory model, in which number of pupils per classroom is positively related to achievement performance levels. Could it be simply that efficient schools are able to get by with fewer physical facilities merely by virtue of their overall efficiency?

2. Adding Number of Students per Classroom and Deleting Teacher Certification Level

The second alternative explanatory model was suggested by a factor analysis of the data. A six factor rotation which seemingly best fitted the data is presented in Table 17 for 20 school and community variables. The factors seem relatively easy to interpret into the following:

Factor Number	Factor Description
I.	Wealth; size (direction negative to wealth)
II.	Socio-economic level and pupil performance level.
III.	Intensity of use of physical facilities.
IV.	Teacher characteristics.
V.	Expenditure Levels.
VI.	Socio-economic attributes associated with pupil density per square mile.

The principle explanatory model had school and socio-economic variables which represented four of the six factors. Only factors I and III were unrepresented. Of these, it was decided not to represent the wealth factor on the grounds that socio-economic characteristics were well enough represented* by a stratification scheme and a continuous variable for mother's education. The same cannot be said for the variables represented by factor III however. A check of the sample coefficients of correlation between the variables loading on factor III and the performance measures revealed correlations high enough to suggest that these variables should be taken seriously. An alternate model was therefore constructed which contained the variable which loaded highest on the factor, number of pupils per classroom.

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*An alternative possibility is available here which would suggest that the factor should have been represented however. This is that the factor in fact represents size. This would suggest a model in which average daily attendance is added to the other variables in these models. This alternative was initially ruled out on the basis that the negative wealth variable (state aid per pupil) had the higher factor loading and also because the size variable is not very meaningful for school districts. Thus, the characteristic measured for school districts is not the size of the production process so much as the size of political jurisdiction. Past work by the author has shown that, when enough school and geographical distinctions are accounted for, the importance of size of school districts (and even schools) seems to dwindle to nothing. Said differently, it is strongly suspected that when a significant relationship is found for size, what is in fact being shown is a relationship with some other variable which is closely associated with size. The correct procedure is to find the other variable and include it in the model. Nevertheless, a model including a size variable probably should have been tried.

Table 17

Orthogonal Factor Analysis, 28 School and Community Factors, 86 New York School Districts

Variable	Factor 1	2	3	4	5	6
1. Father Education Level		-.86				-.35
2. Mother Education Level		-.83				
3. Father Occupation Level		-.87				-.30
4. Average Composite Score, All Pupils		.83		.30		
5. Average Composite Score, Fathers Education Level 1		.52				
6. Average Composite Score, Fathers Education Level 4		.45		.38		
7. Wealth per Square Mile	.51					.70
8. Number Pupils per Square Mile	.41					.74
9. Teacher Certification Level				.73		
10. Teacher Degree Level						.58
11. Teacher Experience		-.30		.77		
12. Teacher Salary				.54	-.46	.32
13. Percentage White Students	-.69					
14. Teacher-Pupil Ratio					.42	
15. Administrative Expenditure per Pupil					-.57	
16. Students per School		.36	.52			
17. Students per Classroom			.94			
18. Teachers per Classroom			.92			
19. Students per Academic Classroom			.90			
20. Average Daily Attendance	.71					.31
21. State Aid per Pupil	-.80					-.32
22. General Control Expenditure per Pupil						.65
23. Plant and Maintenance Expenditure per Pupil					-.70	
24. Capital Repayment and Debt Service Expenditure per Pupil					-.61	
25. Approved Operating Expenditure per Pupil					-.75	.41

(Continued next page)

Table 17. (Continued)

Variable	Factor 1	2	3	4	5	6
26. Property Value per Pupil	.62				-.60	
27. Property Tax Revenue per Pupil	.41				-.68	.41
28. School Tax Rate	-.47			-.35	-.37	.56

Factor Representation	Wealth; Size	Socio-Economic Level; Achievement Performance	Intensity of use of Physical Facilities	Teacher Characteristics	Expenditure Levels	Community Economic Characteristics According to Degree of Urbanization
Cumulative percentage of Total Variance Explained	.25	.39	.50	.58	.65	.70
Eigenvalue	7.11	3.84	3.05	2.25	1.96	1.34

Notes: Only factor loadings greater than or equal to 0.3 are given.

The BMD 03M Algorithm was used to obtain orthogonal factors using a varimax rotation.

In making this change, the occasion presented itself for investigating another hypothesis. Since the teacher salary variable in the earlier study had been positively related to pupil performance quite often, and because the correlation between the teacher certification variable and the teacher salary variable in these data was relatively high (0.43), it was hypothesized that the poor showing from the salary variable might be due to the inclusion of the certification variable. Therefore it was decided to omit the certification variable from this variant of the model to see what would happen to the salary variable.

The fitted regression equations for this third model are presented in Tables 18 and 19 for pupil populations stratified by education in grades 5 and 8. They can be quickly summarized. First, removal of the certification variable does not increase the relationship of teacher salary to pupil performance. What it does instead is to make the teacher experience variable appear much more significant than before. Secondly, the variable for number of pupils per classroom is positively related to pupil performance. In 7 out of 12 possible instances the relationship is statistically significant at the 10% level or better. Both of these findings are worthy of further comment.

Why should teacher salary be so important for the earlier data and unimportant here? The explanation that is most available for this is that the quality of the second salary variable is much lower than the first one. Average teacher salary is basically a function of experience in the given school district. As such, average salary level for a given district depends most importantly upon the age distribution of the teachers within the district and this may not be random. If, to take an extreme example, a school district had only old teachers who were on the point of retiring, average salary would be very high but average teacher quality would not be correspondingly high. In the earlier study the average salary of teachers of the top decile of teachers according to salary was used. This variable would be much more comparable since for the top decile experience levels would probably be comparable and differences would be more directly related to school salary policy. Another salary variable which might have been better is starting salary.

A second aspect of the salary variable which should be maintained is the fact that there may have been some errors in the BEDS data as summarized by the author. A simple alternative variable for salary could be obtained from salary schedules published by the New York State Teachers Association and the author intends to try such a variable if the opportunity presents itself at some later time.

The finding for number of pupils per classroom is more intriguing. It suggests the contrary of what is suggested by economic theory and common sense, i.e., that the fewer the physical facilities per pupil (or per teacher, these variables are interchangable) the better is the quality of the production process. Again this finding could be due to faulty variable construction, although the summary algorithm was carefully checked against actual means and found to give correct answers. Also, the information seems quite internally consistent. An alternative explanation is that school districts which are efficient generally are also efficient with respect to using available facilities. What this means to the economist is that for these existing sets of plant and equipment (school districts) physical facilities represent no

Table 18
Fitted Regression Equations for Alternate Model Two, Composite Score, Grade 5

Father Education	Inter-cept	Mothers' Education Level	Teacher Degree Status	Teacher Exper-ience.	Average Teacher Salary	Pupil-Teacher Ratio	Adminis-trative Expendi-ture Per Pupil	Pupils Per Classroom	N	$\bar{m}$	$\bar{s}$	R^2
1. 4 or More Years of College	7.303 (0.332)	-0.538 (5.32)**	0.211 (0.65)	0.050 (3.37)**	-0.018 (2.08)*	-0.0055 (0.36)	0.087 (1.85)+	0.0087 (0.85)	84	6.08	0.40	.380
2. 1-3 Years of College	7.104 (0.334)	-0.648 (6.03)**	-0.166 (0.52)	0.052 (3.90)**	-0.0070 (0.80)	-0.017 (1.08)	0.129 (2.35)*	0.012 (1.45)	84	5.59	0.43	.455
3. High School Graduate	5.997 (0.304)	-0.318 (3.12)**	-0.127 (0.47)	0.033 (2.94)**	-0.0061 (0.78)	-0.012 (0.97)	0.146 (3.34)**	0.014 (1.76)+	85	5.28	0.34	.274
4. 10-11+ Years of Schooling	5.737 (0.340)	-0.497 (4.12)**	-0.041 (0.14)	0.040 (3.50)**	-0.0089 (1.00)	-0.00021 (0.01)	0.174 (3.22)**	0.016 (1.74)+	85	4.93	0.39	.319
5. 7-9 Years of Schooling	4.903 (0.329)	-0.437 (3.57)**	0.040 (0.14)	0.037 (3.46)**	-0.0052 (0.59)	-0.0034 (0.25)	0.161 (3.44)**	0.020 (2.31)*	85	4.65	0.37	.291
6. 1-6 Years of Schooling	5.723 (0.475)	-0.394 (2.02)*	-0.197 (0.40)	-0.0038 (0.23)	-0.014 (0.92)	0.027 (0.94)	0.145 (1.84)+	0.014 (0.71)	73	4.26	0.40	.117
7. No Formal Schooling	Not Computed											

Notes: See page 34.

Table 19

Fitted Regression Equations for Alternate Model Two, Composite Score, Grade 8.

Father Education	Intercept	Mother Education Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	Pupils Per Classroom	N	$\bar{m}$	$\bar{\bar{s}}$	R^2
1. 4 or More Years of College	9.510 (0.423)	-0.594 (4.60)**	0.406 (0.95)	0.051 (2.60)*	-0.0093 (0.85)	0.024 (1.29)	-0.057 (0.94)	-0.0088 (0.64)	81	9.23	0.49	.335
2. 1-3 Years of College	8.902 (0.424)	-0.537 (3.92)**	0.410 (1.01)	0.031 (1.81)+	-0.019 (1.78)+	0.012 (0.58)	0.189 (2.91)**	0.024 (1.93)+	83	8.53	0.48	.307
3. High School Graduate	7.996 (0.411)	-0.276 (1.94)+	-0.210 (0.56)	0.038 (2.47)*	-0.0068 (0.67)	0.033 (1.98)+	0.143 (2.35)*	0.020 (1.95)+	85	8.17	0.44	.225
4. 10-11+ Years of Schooling	6.061 (0.482)	-0.346 (2.06)*	-0.308 (0.70)	0.027 (1.59)	0.012 (0.93)	0.024 (1.21)	0.243 (3.17)**	0.042 (3.21)**	85	7.64	0.54	.274
5. 7-9 Years of Schooling	4.713 (0.671)	-0.171 (0.67)	0.034 (0.06)	0.022 (1.00)	0.0042 (0.21)	0.041 (1.59)	0.314 (3.30)	0.043 (2.46)	85	7.21	0.71	.201
6. 1-6 Years of Schooling	5.453 (0.848)	-0.612 (1.83)+	-0.059 (0.06)	0.0069 (0.20)	0.028 (0.96)	-0.020 (0.45)	0.259 (1.62)	0.033 (1.46)	67	6.97	0.86	.146
7. No Formal Schooling	Not Computed.											

Notes: See page 34.

constraint whatsoever on quality of instructional program. If true, this is a most important finding.

There is one characteristic of American schools which would seem to support such a conclusion, although the evidence of its truth has itself never been established. This is the fact that American public school systems, especially those within the same state, tend to use highly similar configurations of physical facilities. Further work on this point would be useful.

Geographical Differences in the Relationships

In the 1958 New York sample of schools it was found that achievement performance levels were much more regularly related to school inputs in urban and large school districts than in village and rural school districts. In the present study there is much less difference between these types of school districts.

New York education personnel carefully distinguished key geographical characteristics of the school districts in the 1965 sample mainly on the basis of population density and location relative to standard metropolitan statistical areas. By density the districts were simply divided into two groups--urban and rural. But population density is not the only important geographical consideration for schools. In his work concerning teacher quality in a sample of Indiana schools, Richard Turner has shown that the quality of professional opportunities available for teachers' husbands, as well as the availability of cultural attractions in general are most important to successful teacher recruitment. While there are numberous exceptions, it might be hypothesized that metropolitan areas would be more likely to have these desirable characteristics than more isolated village and rural areas. A somewhat less strong alternative hypothesis is that the quality of cultural and professional opportunities across village and rural school districts is much more uneven. Such a phenomenon could explain the author's earlier finding where the performance of the village and rural school districts was highly random. Perhaps additional explanatory variables representing professional opportunities and cultural attractions were necessary to explain the performance of these schools.

The primary explanatory model was fitted to the various combinations possible of rural and urban districts according to location within and outside of standard metropolitan statistical districts (SMSA's). The only conclusions possible from the resultant findings are that locational differences are not important in general but that location inside the SMSA seems to be somewhat more related to predictability than urbanness per se. The urban-rural and SMSA findings are presented in Tables 20-23. Further breakdowns, such as urban districts within and outside SMSA's and rural districts outside SMSA's displayed relationships in which the model's predictive power was minimal.

Insofar as the differences between districts located inside and outside of SMSA's are meaningful (and with no concomitant differences according to the rural-urban breakdown) the findings support the hypothesis discussed above based on Turner's work.

Table 20
Fitted Multiple Regression Equations, Urban School Districts, Grade 5.

Father Education Level	Inter-cept	Mother Education Level	Teacher Certi-fication Level	Teacher Degree Status	Teacher Exper-ience	Average Teacher Salary	Pupil-Teacher Ratio	Adminis-trative Expendi-ture Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. 4 or More Years of College	4.223 (0.283)	-0.477 (3.07)**	1.035 (2.09)*	0.140 (0.33)	0.022 (0.90)	-0.022 (1.78)†	0.008 (0.41)	0.017 (0.24)	37	6.02	0.37	.544
2. 1-3 Years of College	3.712 (0.299)	-0.383 (2.19)*	0.977 (1.81)†	-0.286 (0.58)	0.035 (1.37)	-0.012 (0.82)	-0.0032 (0.15)	0.141 (1.52)	37	5.48	0.38	.523
3. High School Graduate	2.906 (0.283)	-0.140 (0.80)	1.055 (2.12)*	-0.495 (1.06)	-0.0059 (0.24)	-0.0025 (0.18)	-0.0041 (0.21)	0.086 (1.00)	37	5.19	0.30	.294
4. 10-11† Years of Schooling	2.013 (0.322)	-0.294 (1.41)	1.276 (2.31)*	-0.276 (0.51)	0.0012 (0.04)	-0.013 (0.82)	0.010 (0.42)	0.161 (1.46)	37	4.84	0.36	.350
5. 7-9 Years of Schooling	1.831 (0.288)	-0.289 (1.46)	0.360 (0.79)	-0.066 (0.15)	0.030 (1.34)	0.014 (0.93)	0.020 (0.96)	0.200 (1.92)†	37	4.56	0.32	.378
6. 1-6 Years of Schooling	6.885 (0.383)	-0.723 (2.33)*	0.912 (0.99)	-1.368 (1.95)*	-0.092 (2.23)*	-0.014 (0.50)	0.045 (1.27)	-0.033 (0.18)	35	4.19	0.41	.324
7. No Formal Schooling	-10.408 (0.913)	-0.245 (0.26)	6.943 (1.45)	-2.884 (0.96)	-0.140 (0.51)	-0.043 (0.44)	0.0094 (0.08)	0.716 (0.66)	17	4.20	0.85	.359

Notes: See page 34.

Table 21
Fitted Regression Equations, Rural School Districts, Grade 5.

Father Education Level	Intercept	Mother Education Level	Teacher Certification Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. 4 or More Years of College	6.223 (0.408)	-0.247 (1.22)	0.212 (0.40)	0.695 (1.18)	0.00086 (0.03)	-0.025 (1.68)	-0.032 (1.07)	0.360 (2.99)**	46	6.26	0.43	.345
2. 1-3 Years of College	5.981 (0.385)	-0.386 (1.94)+	0.128 (0.27)	0.162 (0.32)	0.012 (0.47)	-0.0038 (0.30)	-0.0071 (0.28)	0.081 (0.85)	46	5.94	0.38	.142
3. High School Graduate	3.985 (0.317)	-0.189 (1.23)	0.799 (2.49)*	0.147 (0.46)	-0.0016 (0.09)	-0.020 (1.98)+	-0.0072 (0.51)	0.165 (2.39)*	47	5.51	0.33	
4. 10-11+ Years of Schooling	4.708 (0.357)	-0.320 (1.93)+	0.172 (0.55)	-0.039 (0.11)	0.011 (0.60)	0.0015 (0.13)	0.015 (0.93)	0.057 (0.74)	47	5.23	0.36	.170
5. 7-9 Years of Schooling	4.785 (0.372)	-0.255 (1.43)	0.126 (0.43)	0.328 (0.95)	0.014 (0.66)	-0.0051 (0.38)	-0.0055 (0.35)	-0.032 (0.44)	47	4.91	0.37	.154
6. 1-6 Years of Schooling	2.258 (0.642)	-0.297 (0.95)	0.708 (1.14)	0.970 (1.21)	0.0062 (0.16)	-0.028 (1.10)	0.022 (0.48)	0.045 (0.30)	37	4.55	0.63	.182
7. No Formal Schooling	Not Computed.											

Notes: See page 34.

Table 22
Fitted Regression Equations; School Districts Inside Standard Metropolitan Statistical Areas, Composite Score, Grade 5

Fathers' Education Level	Intercept	Mothers' Education Level	Teachers Certification Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. 4 or More Years of College	3.533 (0.304)	-0.474 (3.23)**	1.116 (2.04)*	0.446 (0.89)	0.027 (1.12)	-0.027 (2.17)*	0.014 (0.62)	0.038 (0.55)	39	6.06	0.40	.541
2. 1-3 Years of College	4.936 (0.311)	-0.622 (3.51)**	0.914 (1.65)	-0.288 (0.51)	0.017 (0.67)	-0.014 (1.06)	-0.0017 (0.07)	0.099 (1.05)	39	5.56	0.43	.587
3. High School Graduate	3.967 (0.294)	-0.238 (1.40)	1.102 (2.15)*	-0.637 (1.19)	-0.0090 (0.35)	-0.010 (0.81)	-0.0077 (0.38)	0.112 (1.33)	39	5.25	0.34	.388
4. Completed at Least Grade 10; No High School Diploma	3.593 (0.318)	-0.488 (2.38)*	-1.048 (1.95)+	0.355 (0.58)	-0.023 (0.86)	-0.020 (1.44)	0.017 (0.69)	0.222 (2.11)*	39	4.91	0.40	.501
5. 7-9 Years of Schooling	4.409 (0.336)	-0.419 (1.79)+	0.680 (1.23)	-0.549 (0.86)	0.0087 (0.34)	-0.011 (0.67)	0.010 (0.41)	0.217 (1.91)+	39	4.59	0.36	.312
6. 1-6 Years of Schooling	5.317 (0.415)	-0.555 (1.63)	0.624 (0.60)	-0.250 (0.26)	-0.049 (1.12)	-0.029 (1.21)	0.056 (1.42)	0.170 (0.86)	33	4.19	0.45	.342
7. No Formal Schooling	-3.703 (0.787)	-2.579 (1.77)	4.485 (0.78)	0.936 (0.25)	-0.288 (0.69)	0.017 (0.19)	0.187 (1.51)	-0.456 (0.28)	13	4.17	0.81	.560

Notes: See page 34.

Table 23
Fitted Regression Equations, School Districts Outside Standard Metropolitan Statistical Areas, Composite Score, Grade 5

Fathers' Education Level	Intercept	Mothers' Education Level	Teacher Certification Level	Teacher Degree Status	Teacher Experience	Average Teacher Salary	Pupil-Teacher Ratio	Administrative Expenditure Per Pupil	N	$\bar{m}$	$\bar{s}$	R^2
1. 4 or More Years of College	8.048 (0.387)	-0.427 (2.04)*	0.334 (0.76)	-0.430 (0.86)	-0.0084 (0.26)	-0.015 (0.74)	-0.019 (0.87)	0.185 (1.92)÷	44	6.16	0.39	.203
2. 1-3 Years of College	6.687 (0.404	-0.209 (0.92)	0.144 (0.30)	-0.0033 (0.01)	0.054 (1.98)÷	-0.018 (0.90)	-0.023 (0.83)	0.034 (0.42)	44	5.71	0.41	.192
3. High School Graduate	3.155 (0.319)	0.025 (0.14)	0.747 (2.37)*	-0.023 (0.08)	0.0036 (0.18)	-0.0093 (0.72)	-0.0060 (0.45)	0.115 (2.04)*	45	5.36	0.34	.270
4. Completed at Least Grade 10; No High School Diploma	2.531 (0.362)	0.030 (0.16)	0.567 (1.67)	-0.015 (0.04)	-0.0098 (0.47)	0.0021 (0.15)	0.0033 (0.20)	0.124 (1.76)÷	45	5.01	0.36	.146
5. 7-9 Years of Schooling	3.943 (0.339)	-0.194 (1.13)	-0.128 (0.44)	0.536 (1.82)÷	0.051 (2.51)*	-0.00066 (0.05)	-0.0031 (0.21)	0.026 (0.44)	45	4.79	0.36	.246
6. 1-6 Years of Schooling	3.714 (0.486)	-0.082 (0.32)	0.672 (1.37)	0.149 (0.30)	0.0030 (0.10)	-0.0047 (0.26)	-0.056 (1.58)	-0.172 (1.83)÷	39	4.51	0.50	.241
7. No Formal Schooling	0.212 (0.830)	0.312 (0.24)	-0.026 (0.01)	2.276 (1.20)	0.189 (0.91)	0.022 (0.11)	-0.235 (1.36)	-0.218 (0.74)	12	4.48	0.81	.594

Notes: See page 34.

Relationships by School Building

Very little work has been done in the past on the important question concerning the consequences of aggregating public school data into school districts. A number of studies have used the school building as the primary unit of observation; among them, those by Katzman, Project Talent, and the Equal Opportunity Survey. The author's prior New York work utilized the school district as the observation. Considerable importance rides on the effects of doing this. If there is substantial within-district variation in school inputs and outputs the use of school district averages may not be meaningful.

The New York State Basic Education Data System collects information concerning teacher characteristics, number of classrooms, and the like by school building as well as by school district. Unfortunately, we found in summarizing these data that some of the data were incompletely filled in by respondents and therefore untrustworthy. This was especially true data concerning physical variables. Nevertheless, with considerable effort, we summarized most of the school variables which were present in the BEDS data, taking special pains to note the number and nature of missing observations for each variable. This summary yielded essentially complete information for a number of variables mainly having to do with teacher characteristics. This was fortunate since teacher characteristics comprise the aspect of school inputs which are probably most suspect concerning non-random within-district variations, the supposed mechanism being the transfering of teachers to schools with better motivated pupils. We decided that three important teacher characteristics would be enough to test for significant between-school differences: Degree level, average salary, and number years of experience In light of the subsequent finding of importance for the certification variable it was probably a mistake to omit that variable, although certification had somewhat more missing observations than did the three variables used. One other variable available by school building was pupil socio-economic level. Without a variable describing the socio-economic "climate" of the school building no meaningful analysis could be made since it is mostly on the basis of such "climate" differences that we suspect other non-random differences in teacher characteristics to obtain.

Two questions are of interest. First, are within-district differenc in socio-economic and teacher characteristics relatively large, and second, if large, then are they random or do they vary in some important way? To investigate these questions eight populations were compared: Five individual city school districts (Albany, Binghamton, Schenectady, Syracuse, and Niagara Falls), all schools in districts with six schools or more, schools in districts with five schools or less, and all schools. This was done for grade five only where there are approximately three times as many school buildings as are present in grade eight. In many junior-high schools there is already much amalgamation of pupils coming from very different elementary schools (at least, hypothesized as such) and therefore grade five schools are more proper subjects for this kind of analysis.

One can investigate the first question with analysis of variance techniques or simply by comparing the standard deviations of the five

Table 24

Between School Standard Deviations for Four Important Variables, All Schools, Schools in Districts with Six or More Schools, Schools in Districts With Less Than Six Schools, and Five Large City School Districts

School Population	Standard Deviations Composite Achievement Test Score	Father Education Level	Teacher Degree Level	Teacher Salary	Teacher Experience	N
All Schools	0.61	0.72	0.45	713	4.50	273
Schools in Districts With Six or More Schools	0.67	0.75	0.45	657	5.02	144
Schools in Districts With Five or Less Schools	0.46	0.68	0.44	769	3.81	129
Albany	0.83	0.78	0.33	737	6.14	18
Binghamton	0.51	0.63	0.26	572	4.06	13
Schenectady	0.67	0.70	0.27	683	4.95	18
Syracuse	0.75	0.92	0.23	573	4.72	29
Niagra Falls	0.49	0.63	0.30	500	3.48	20

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Table 25

Analysis of Variance Results Comparing Variation in Five Key Variables Within and Between School Districts, All School Districts and School Districts With Four or More Schools

Variable	F-Ratios	
	All (79) School District DF = 78,194	24 School Districts With 4 or More Schools DF = 23,178
Composite Achievement Performance Grade 5	1.83*	3.82**
Father Education Level, Pupils in Grade 5	1.87*	3.36**
Teacher Degree Status	4.26**	6.32**
Years of Teacher Experience	1.19	2.46**
Teacher Salary	2.49**	3.75**

* Significant at the 1.0 percent level.
** Significant at the 0.1 percent level.

variables being used (achievement performance, plus the four given above) for the eight populations just described. The standard deviations are presented in Table 24. Greater within-district differences apparently exist in larger districts in achievement performance, but not in the other variables (the exception is Binghamton). There is a bit more variation in large districts in the average father education variable also, although not nearly so much as that displayed by composite scores. The same is true with teacher experience levels. Variation in teacher salaries and degree levels is appreciably less in the five large districts than in the larger groups. There is no difference in teacher degree variation between many-school and few-school districts however.

Analysis of variance is a more rigorous way to compare within and between district variation. F-ratios for five variables for all school districts (with no missing observations) and for school districts with four or more grade schools are given in Table 25. All of the ratios except that for teacher experience in all districts are significant at the one percent level. The ratios for all districts are not completely meaningful however, since 44 districts had only one elementary school. The more meaningful ratios are those presented in the second column of the table for school districts which have four or more schools. With the exception of teacher experience, F-ratios for those districts are all highly significant.

These relationships suggest that between-district differences in school inputs are considerably more important than within-district differences. This is especially so with degree level; less true with the other two teacher variables.

Having established this much, next we wish to ask whether the within-district variations are systematic in some meaningful way. This can be checked two ways: Using multiple regression explanatory within-district models, and simply by consulting simple coefficients of correlation. The most important hypothesis to test in doing this is whether variations in teacher characteristics (by school building) are related to socio-economic levels of schools, or to differences in pupil performance. Positive relationships would indicate teacher transfer patterns away from low SE buildings. In particular, we should investigate whether average achievement performance is related to teacher characteristics when allowance is not made for differences in socio-economic level (which is of course what we have in a zero order correlation coefficient). If no or little relationship exists between these two variables and teacher characteristics, the district is assigning teachers more or less at random; if the relationship is negative the district is probably assigning better teachers to deal with children from relatively disadvantaged backgrounds.*

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*This argument of course assumes that (relatively large) between-school differences in socio-economic level of pupils is a much more important factor in determining achievement outcomes than (relatively small) between-school differences in teacher skills. Most readers should find this assumption plausible.

Table 26

Simple Correlation Coefficients Between Average Composite Score and Father Education Level and Three Teacher Variables Taken by School Building, Five Large School Districts, School Districts With Six or More Schools, School Districts With Five or Less Schools, and all School Districts.

School District Population	Correlation Coefficients Teacher Degree Level	Years Teacher Experience	Teacher Salary
All School Districts			
Composite Score	-.02	.19*	.03
Father Education	-.08	-.29*	.01
School Districts with Six or More Schools			
Composite Score	-.14	.13	[illegible]
Father Education	.09	-.15	-.14
School Districts With Five or Less Schools			
Composite Score	.09	.26*	-.06
Father Education	-.27*	-.43*	.22*
Albany			
Composite Score	-.09	-.02	-.01
Father Education	-.07	-.18	-.14
Binghamton			
Composite Score	.08	.03	.12
Father Education	-.20	-.24	-.26
Niagra Falls			
Composite Score	-.01	-.24	-.39
Father Education	.19	.03	.02

Table 26. (Continued)

School District Population	Correlation Coefficients Teacher Degree Level	 Years Teacher Experience	 Teacher Salary
Schenectady			
Composite Score	-.63	-.01	-.01
Father Education	.16	.11	.18
Syracuse			
Composite Score	-.13	.12	.15
Father Education	.19	-.18	-.26

Expected Signs: For positive relationships the proper sign for score is positive and education negative.

* ≡ Significantly different from zero at the 5 percent level of confidence.

Two of the five large city districts have teacher characteristics distributed somewhat contrary to the socio-economic level of school buildings (See Table 26). The other three have teacher characteristics which vary weakly according to average education level of fathers (no correlation coefficient in the five large districts is significantly different from zero at the 5% level of significance), although there is no consistent relationship at all between teacher characteristics and achievement performance. An interesting comparison is that between schools in large and small districts. The latter would in fact show relatively more variation between districts and the former variation within districts. The differences in the correlation coefficients between the two groups of districts is striking with the relationships for the small districts being much stronger. To summarize, within-district non-random relationships between teacher and school socio-economic characteristics seem to be weakly present in some districts and completely absent in others.

Regression Findings by School Building

As indicated above, we constructed a simple model to test for within district relationships between the three teacher characteristics and average father education level which were net of the effects of the other variables. The fitted regression equations appear in Tables 27 and 28. Two equations were fitted, the difference being the exclusion of the mother education variable. The reason for this is that low levels of statistical significance for the three teacher variables could possibly be caused by a high amount of colinearity with the education variable.

The fitted regressions for the school building data demonstrate as a general finding that relationships between performance and teacher characteristics is markedly less in the five large individual districts than for all schools considered together. This is even more true when the mother occupation variable is omitted from the model. This finding reinforces the findings shown in the analysis of variance and correlation analyses above. In four of the individual districts only one variable is significantly related to performance while in the fifth (Niagara Falls) none is. Significance levels are never very high. When all schools are considered, on the other hand, significance levels for two of the variables are quite high. It should be noted, however, that the significance levels of the two significant teacher variables are somewhat greater for the schools from districts having six or more schools than those in districts having five or less. From this it would appear that it cannot be concluded that within-district differences are unimportant.

To conclude with respect to within-district variations, it would seem that Turner's general finding concerning district variations is supported to a sufficient enough extent to allow us to conclude that studies of school districts, such as the author's first New York study, are meaningful enough to be taken seriously, at least, by policy makers. There are enough aggregation errors present however that we should also conclude that such studies are less important in attempting to construct accurate educational production functions in the engineering

Table 27

Fitted Regression Equations by School Building, Mother Education Variable Included

School Population	Intercept	Mother Education Level	Teacher Degree Status	Average Teacher Salary	Teacher Experience	N
All Schools	0.683 (0.620)	-0.393 (7.74)**	0.377 (5.46)**	0.00045 (8.87)**	-0.0088 (0.95)	273
Schools in Districts With 6 or More Schools	0.277 (0.585)	-0.603 (9.49)**	0.386 (4.67)**	0.00058 (8.97)**	-0.603 (2.76)**	144
Schools in Districts With 5 or Less Schools	1.180 (0.558)	-0.131 (1.70)+	0.268 (2.53)*	0.00041 (5.47)**	-0.0040 (0.26)	129
Albany	0.534 (0.371)	-1.000 (9.69)**	1.121 (2.75)**	0.00020 (0.61)	-0.056 (2.28)*	18
Binghamton	-0.357 (0.535)	-0.232 (0.77)	0.986 (1.83)+	0.00027 (0.62)	-0.039 (0.58)	13
Niagara Falls	0.672 (0.514)	-0.710 (0.99)	0.0014 (1.46)	-0.210 (1.69)	-0.342 (1.76)+	20
Schenectady	0.554 (0.445)	-0.800 (4.79)**	0.848 (2.05)*	0.00024 (0.78)	-0.055 (1.69)	18
Syracuse	-0.216 (0.400)	-0.734 (8.75)**	0.471 (1.44)	0.00071 (2.15)*	-0.061 (1.39)	29

Notes: See page 34.

Table 28

Fitted Regression Equations by School Building, Mother Education Variable Excluded

School Population	Intercept	Teacher Degree Status	Average Teacher Salary	Teacher Experience	N
All Schools	0.187 (0.685)	0.236 (3.21)**	0.00052 (9.30)**	-0.0159 (1.56)	273
Schools in Districts With 6 or More Schools	-0.330 (0.749)	0.203 (1.98)+	0.00059 (7.13)**	-0.0169 (1.19)	144
Schools in Districts With 5 or Less Schools	0.998 (0.562)	0.210 (2.08)*	0.00045 (6.44)**	-0.0145 (1.02)	129
Albany	-0.508 (1.025)	-0.273 (0.26)	0.0010 (1.19)	-0.057 (0.85)	18
Binghamton	-0.713 (0.523)	1.134 (2.31)*	0.00012 (0.32)	-0.021 (0.34)	13
Niagara Falls	-0.705 (0.502)	-0.700 (1.06)	0.0015 (2.73)**	-0.225 (2.86)**	20
Schenactady	-0.745 (0.712)	0.812 (1.23)	0.00026 (0.53)	-0.087 (1.69)	18
Syracuse	-0.994 (0.803)	0.040 (0.06)	0.00084 (1.26)	-0.029 (0.33)	29

Notes: See page 34.

sense. The only way to do this properly is to gather data in units proper to each variable. Since important policy relevant variables have relevant units of observation going from the school district level to the classroom and individual pupil, treating these observational units properly is a design problem difficult to overcome.

III

SUMMARY AND CONCLUSION

Central Findings of the Study Summarized

The main findings of this investigation can be presented rather briefly. First, relationships in smaller school districts were shown to be somewhat less unpreditable than those in the 1958 study. Indeed, no urban-non-urban differences were discovered at all in these districts a finding distinctly different than that in the earlier study. Some differences were noted according to location inside of Standard Metropolitan Statistical Areas however, and this fits rather well into some hypothesized relationships based on work of Richard Turner.

Taking both New York studies together, the strongest and most consistently important school input seems to be resources put into central administration. In light of the deep preoccupation with the importance of the classroom teacher which pervades American education, this finding is of considerable importance. Two other relationships were similar in both studies. Average levels of parent education and/or occupation were again shown to be highly related to pupil performance. This is certainly to be expected of course, and any other consistent finding would render the explanatory model suspect. Secondly, the 1965 data again show the essential unimportance (at least apparently) of class size to educational outcomes within the range of experience represented in these New York schools. The implications of this finding should be obvious to all, although it would be extremely dangerous to carry them too far. More specifically, extrapolation of this finding beyond the range of class sizes found in these New York school districts would be foolhardy indeed.

Some other findings from the earlier study were not very well replicated, however. The most notable of these was the relationship between teacher salary and pupil performance. Value of school district-owned property per pupil was also found to be unrelated to achievement performance in the present study, whereas it had often been positively associated to performance in the earlier one.

It might be possible, finally, to draw a general conclusion from both New York studies: it seems obvious that both school and community inputs are important to the success of public education.

Practical Implications to Policy Makers

What practical implications of this kind of analysis are possible? Perhaps two types can be listed. The first is descriptive. Many of the findings presented above can be interpreted merely as being descriptive of schools when certain sets of influences are held constant. Surely more information is always valuable to the decision maker concerning the effectiveness of aspects of his organization.

Secondly, the findings may be more directly applicable. Henry Levin has argued that findings from data generated by the Coleman Report suggest rather insistently that school leaders should aim policy towards acquiring teachers with improved verbal achievement rather than the more traditional objectives of greater experience, more advanced degrees, and the like.* Levin even makes some quantitative statements in which the claim is made that money spent on teacher experience is on the order of five to ten times less effective than money spent on acquiring teachers with better verbal ability. Such a finding should be at least highly suggestive to policy makers. The findings in the present study would seem to suggest in similar fashion that preparation in the teacher's subject area is important while degrees _per se_ are not, and that resources devoted to supervision are important. These supervision relationships are not inconsistant with findings in some work being done by the author at the RAND Corporation which suggest that effective in-service training of teachers with respect to instructional problems actually faced in their work situations is highly important to instructional success.

The author feels that investigations of this nature, especially with respect to elementary public education, are relevant and revealing enough to justify considerably more effort in the area in the future, whether or not economists ever succeed in constructing actual "engineering" production functions for schools.

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*Henry M. Levin, "A Cost-Effectiveness Analysis of Teacher Selection," _Journal of Human Resources_, Vol. 5, No. 1 (Winter, 1970), pp. 24-33.